

*Compliments of
C. L. Marlatt*

REPORT
ON
WINE MAKING
IN
FRANCE.

BY
C. L. MARLATT, M. S.

AUTHOR'S EDITION.

From the Reports of the U. S. Commissioners to the Universal Exposition of 1889
at Paris, Vol. V, Agriculture.

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consists of a rubber plate fastened to the concave base of the reservoir. To the center of this plate is attached the lever, and by the action of the latter the plate is raised and lowered and the air above the plate compressed and forced into the reservoir through the curved tube shown in the figure (See Fig. 64). The escape of the air at the base of the reservoir answers the purpose of an agitator. The nozzle is the Noël modification of the Riley type. The price of the apparatus is about 60 francs.

The final class of machines for spraying to which attention will be drawn is that in which the pump is entirely separate from the reservoir, being connected with the latter by a rubber hose. These pumps are in general harder to work and less effective than the other forms described in which the pump is solidly fixed to the reservoir. However, in certain localities, particularly in the Bordelais district, the syringe pumps are very well thought of by the vineyardists.

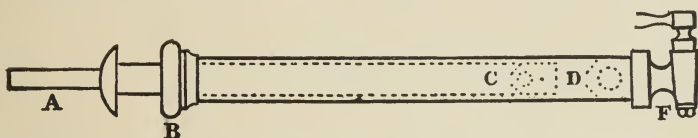


FIG. 159.—The syringe pump of the Gretillat apparatus. (From Viala et Ferrouillat.)

As a type of these pumps the Gretillat apparatus, called the "Rapid," may be noted. The knapsack reservoir will contain about 12 liters, and is connected by means of a rubber tube with the syringe pump shown at Fig. 159. The nozzle (Fig. 160) is of the colliding-jet type and may be adjusted by turning the stopcock to deliver a single stream, to free it of any solid body. This apparatus has been employed widely and successfully in Bordelais for several years. Its price is 30 francs with copper reservoir, or 26 francs with zinc reservoir. Other machines of this class are manufactured by Japy Frères, Bourdil, Vermorel, and others.

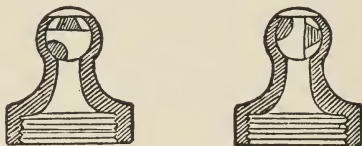


FIG. 160.—The Gretillat nozzle. (From Viala et Ferrouillat.)

It will be observed that the knapsack pumps range in capacity from 12 to 15 liters, the latter amount being about the limit that can be easily carried by a workman. Of the different materials of which the reservoirs are constructed, the red copper is very resistant and is not generally altered by contact with cupric mixtures; brass is less durable, but may be used without injury with the Bordeaux mixture.

For Eau Celeste, and even the sulphate of copper, the reservoir should be of red copper or of brass covered with lead.

If the rubber lining proves satisfactory it may be used with advantage in connection with the acid solutions of sulphate of iron in

the winter treatment of anthracnose, since the red copper even is affected by this solution.

The nozzles are commonly of copper and also of hardened caoutchouc, the latter being especially of service in spraying the acid sulphate of iron. Metal nozzles are rapidly acted on by this substance and ruined.

PART III.—WINE-MAKING.

By C. L. MARLATT.

GENERAL CONSIDERATIONS.

The manufacture of wines has an importance in France which it attains nowhere else, and the true Frenchman is as jealous of the reputation of the grand wines of Bordeaux, Bourgogne, and Champagne as he is of "La belle France" herself. The study of the processes and methods of wine-making has been prosecuted by the intelligent vineyardists of France for centuries, and the literature of the subject has grown to enormous proportions.

The Frenchman is fond of his native wines and neglects no opportunity to improve them or to extol their supreme merits and excellencies, and as a matter of fact he is supported in this last by the judgment of the world. That cheap and comparatively inferior wines—second and third wines, raisin wines, etc., and the poorer wines of certain sections—are also produced is admitted, and when these are disposed of under their true character, as the law compels in France, no objection can be raised.

The adulteration of wines by unscrupulous wine merchants and middlemen in this country as well as in France, or the disposal of inferior wines, second wines, or raisin wines under false labels, is nowhere deplored more than in France by those who have the reputation of the vine industry of the country at heart, and the French Government has passed stringent regulations to prevent falsification of wine within her borders for the protection, at least, of home consumers.*

* FALSIFICATION OF WINES IN FRANCE.

REPORT BY CONSUL DUF AIS, OF HAVRE.

[Consular Reports, August, 1889, No. 107.]

The official journal of the French Government, of the 15th instant, promulgates a new and important law on the falsification of wines, of which I have the honor to forward herewith a translation.

F. F. DUF AIS, *Consul*.

UNITED STATES CONSULATE,
Havre, August 20, 1889.

LAW OF THE 14TH OF AUGUST, 1889, REGARDING WINES.

The Senate and Chamber of Deputies having adopted, the President of the Republic promulgates the following law :

The student of œnology and particularly the ambitious American grape-grower will, therefore, naturally turn to France and examine her methods if he wishes to familiarize himself with the secrets of an art which though old doubtless as man himself, is yet being added to and improved with every year's experience and becoming more and more subject to laws and rules rather than to experiment and trial.

Formerly wine-making was merely an art, and skill in it, together with its secrets, was handed down from father to son; now it has become more of a science than an art, and any one may familiarize

ARTICLE 1. No one can send forth, sell, or offer to sell under the denomination of wine any other product except that made by fermentation from fresh grapes.

ART. 2. A mixture of the product by fermentation of the residue (*marc*) of fresh grapes with an addition of sugar and water with wine, no matter in what proportion, can only be sold, sent forth, or offered for sale under the name of "Wine of sugar" (*vin de sucre*).

ART. 3. The product of the fermentation of dried raisins with water can only be sent forth, sold, or offered for sale, under the name of "Wine of dried raisins;" it is the same with the mixture of such product with wine, no matter in what proportion.

ART. 4. The casks or other receptacles containing wine of sugar or wine of dried raisins must be marked in large letters "Wine of sugar," "Wine of dried raisins." Books, invoices, waybills, bills of lading, have to give the same designations according to the character of the product.

ART. 5. The bills of circulation accompanying the forwarding or shipment of such wine, wine of sugar, wine of dried raisins, must be of a special color. A ministerial decree will regulate the application of these provisions.

ART. 6. In case of infraction of the above articles the delinquents will be punished with a fine of from 25 to 500 francs, and with imprisonment of from ten days to three months. Article 463 of the penal code will be applicable. In cases of repeated delinquencies the sentence of imprisonment will always be pronounced. Tribunals may, according to the gravity of the cases, order the publishing in newspapers or by bill poster in stated places of such sentences at the expense of the delinquent.

ART. 7. Any admixture to wine, wine of sugar, wine of dried raisins, be it at the time of fermentation or afterwards, of the product either by fermentation or distillation of figs, carob bean (or St. John's bread), flower of mowra, bell flower, rice, barley or other saccharine matter, constitutes falsification of alimentary commodities provided for by law of the 27th of March, 1851.

The provisions of this law are applicable to those who falsify, hold, sell, or offer to sell alimentary produce knowing that it is falsified. Such fraudulent alimentary produce is confiscated according to article 5 of the said law. The present law, discussed and adopted by the Senate and the Chamber of Deputies, will be enforced as the law of the State.

Done at Paris, August 14, 1889.

CARNOT, *President of the Republic.*

The Minister of the Interior,
CONSTANS.

The Minister of Finances,
ROUVIER.

himself with the many steps of the process deduced both from traditional experience and later scientific researches.

The details of the manufacture of wines as recounted in the following pages are necessarily incomplete, but it is hoped that enough is said to give an intelligent appreciation of the fundamental facts and laws, and to enable those interested to compare their own methods with those practiced in France, and adopt such of the latter as are of value or applicable to the conditions of wine-making in the United States. It has been deemed best to describe the entire process of wine-making, and while various steps and methods will necessarily be detailed with which our progressive vineyardists are already familiar, it is believed that much, also, of value to our wine-makers, has by this means been included.

The writer has had access to a large number of the principal French works on wine-making, as well as the leading journals of France devoted to viticulture and vinification, and also the notes of Prof. C. V. Riley resulting from his personal examinations of the methods followed in the celebrated vineyards of central and western France and particularly the Gironde district.

In such a summary treatment of the subject it has been deemed inadvisable to repeatedly note in the text the many authorities consulted. The principal sources of information are mentioned elsewhere. (See p. 31).

The distinct steps in wine-making are: (1) the gathering of the grapes; (2) fermentation; (3) the drawing off of the wine and pressing (*cuvaison*), and (4) the correction and treatment of the crude product necessary to make a perfect wine.

In addition to these must be understood the influence of climate, soil, culture, variety of grape and maturity at gathering, on the nature of the wine. These last will be first briefly considered.

Climate.—In a warm climate such as that of the Midi or Mediterranean regions of France, which includes the lower valley of the Rhône and the borders of the Mediterranean, particularly between Hyères and Vintimille, the grape grows vigorously and produces in the berry a large percentage of sugar. The wine product is, however, lacking in acidity and bouquet and comprises principally the common wines, wines coarse and highly colored, and sweet or strongly alcoholic. Special treatment is necessary to establish a proper equilibrium between the different elements of these wines.

As one approaches the northern limits of the grape regions of France, the proportion of sugar decreases and the acid principles of the grape augment, and in the extreme north, where the grape frequently fails to properly mature, the acid elements (tartaric, tannic, and malic) greatly predominate. The bouquet is also highly developed on account of the low temperature at which fermentation takes place.

Soil.—The influence exerted by the soil is less on the character of the wine than it is on the amount of grapes produced. Wines of equal merit are produced on soils of widely differing composition. On very rich soils, however, the wine product, while abundant in quantity lacks in quality; and, on the other hand, poor soils yield the most highly prized wines, and hence it is that soils not capable of other culture are commonly planted to vines.

Other features of soil and subsoil have been dwelt upon by Prof. Riley in the consideration of vine culture.

Cultural Methods.—The methods of culture adopted with a view to improve and perfect the wine product will depend on the particular conditions of the soil and climate, and on the variety of grape grown. Thorough cultivation favors the ripening of the grape and augments the proportion of sugar in the must.

The practice of summer or green pruning has also been followed from time immemorial in many vineyards to hasten or otherwise influence the ripening and to give to the berry a normal composition, and while this practice has the sanction of long traditional experience, certain recent experiments have indicated from an analysis of the must from pruned and unpruned vines that the percentage of sugar and acidity and the density of the must is considerably lessened and the coloration also is less intense in the case of the pruned vines. The loss of foliage, from which the grapes derive their saccharine strength, would lead one to expect a result similar to the above, and in the limited experiments made the maturation was not hastened but retarded, so that the chief object of the green pruning was not accomplished. This indicates that green pruning should only be practiced, if at all, to accomplish some definite change in the composition of the must, which careful experiment has shown will result from such treatment.

Variety of Grape.—The nature of the wine, depends, of course, largely on the variety of grape grown,—the soil, climate, etc., while exerting considerable influence on the product, are important chiefly in determining what variety shall be grown. In general the early ripening sorts are grown in the north, producing wine of fine quality; and in the south later and more prolific, but inferior sorts.

The vineyards contain either a single or several varieties; in the latter case it is a frequent custom to mix the grapes in wine-making.

Many of the famous French wines are obtained from a single variety or sometimes a combination of two, rarely three, varieties. The mixing of different varieties is frequently desirable to obtain a must of proper composition. M. Rugier mentions the following grapes as those commonly grown in the different wine districts of France:

Bourgogne, *Pineau*; Beaujolais, *Gamay*; Hermitage and surrounding regions, *Petite Syrah*, associated with a white grape in the

proportion of about one-fifth, the latter being either the *Vionnier*, *Marsanne*, or the *Roussanne*; Bordeaux, *Cabernet-Sauvignon* in the proportion of two-fifths, the remaining third being the *Malbec*, *Merlot*, or the *Verdot*. In South France the *Aramon* is the prevailing variety and is associated in the proportion of about one-third with *Petit-Bouschet* or the *Alicante-Bouschet*. In the same region the *Carignan* and *Grenache* are employed to correct the excess of sugar and resulting alcohol in the varieties first named.

It will be seen from the above that in the more advanced viticultural departments of France the number of varieties grown is comparatively limited.

GRAPE GATHERING.—Of the various steps in wine-making grape gathering is chronologically the first and is also the most important. The quality of the wine—its keeping power, its composition and its distinctive aroma and bouquet—is more dependent on the condition of the grape as to maturity, and the precautions in gathering, than on any or all the subsequent steps in vinification.

Maturity of the Grape.—The period at which to gather the grape can only be determined by careful examination and experiment and will vary with different varieties, and under diverse conditions of climate and soil. The determination of the proper maturity of the grape is one of the most important steps in successful wine-making. Picked too soon, there is an excess of acids and a corresponding lack in sugar, while the richness in sugar may be increased by late picking.

In general the grapes are gathered when nourishment from the vine ceases. This condition is characterized by the brownish color of the base of the stem, the softening of the berry and its easy separation from the stem, and the translucent appearance of the skin. The juice, also, has lost its astringency and has become soft and sweet and somewhat sticky.

To determine with greater precision the best time for gathering, various instruments have been invented by the aid of which the proportion of sugar or acids in the must can be accurately estimated. The saccharometer or must scale in most common use and the oldest is the Baumé, a figure of which is given (Fig.



FIG. 161.—The Baumé must scale. (From Portes et Ruysen.)

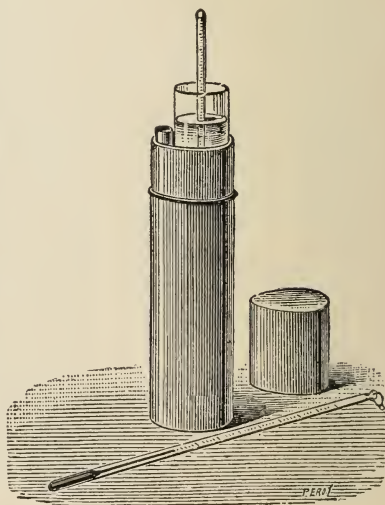


FIG. 162—The Gay-Lussac must scale manufactured by Salleron. (From Rougier.)

161). It consists of a closed graduated tube containing in the lower portion of the enlarged part mercury or lead, and this form of construction is followed in all other instruments of this class. The graduation of the Baumé instrument is altogether arbitrary, but by indicating the density of the must as compared with that of water it is possible to determine the degree of maturity of the must and to calculate the amount of alcohol that will result from its fermentation. The must will vary from 6° to 15°, the best wine being made from must indicating from 8° to 15°.

The must scale of Gay-Lussac, manufactured by M. J. Salleron, gives the density of the liquid direct, the density of water being indicated by the 0 mark, and by means of a table it is possible to approximate very closely the quantity of sugar contained in the must. This instrument is shown at Fig. 162.

The following table is shortened from one prepared by M. J. Salleron to accompany his apparatus and explains itself:

Table employed with the Salleron (Gay-Lussac) must meter.

Density or degrees of the must meter.	Corresponding degrees of the Baumé must meter.	Grams of sugar per liter of must.	Alcohol in wine made from the must.	Crystallized sugar to be added to make a wine of 10 per cent alcohol.	Water to be added per liter of must to reduce the density to 1.075° (10° Baumé).
		<i>Kilos.</i>	<i>Per cent.</i>	<i>Kilos.</i>	<i>Liter.</i>
1,050	6.9	0.103		6	0.068
1,055	7.5	.116	6.8	.054	.....
1,060	8.1	.130	7.6	.041	.....
1,065	8.8	.143	8.4	.027	.....
1,070	9.4	.156	9.2	.013	.....
1,075	10	.170	10	.....	.....
1,080	10.7	.183	10.8	.....	0.06
1,085	11.3	.196	11.5	.....	.13
1,090	11.9	.210	12.3	.....	.20
1,095	12.5	.223	13.1	..	.26
1,100	13.1	.236	13.9	.....	.33

The correction of the must by the application of water or sugar, as indicated in columns 6 and 5, will be considered later on.

A third and very convenient must scale may be mentioned, viz, that of Jules Guyot. This instrument indicates at once, by means of three graduated columns on the stem, the degrees Baumé, the quantity of sugar contained in the must per hectoliter, and the amount of alcohol that will be produced per hectoliter.

This must scale, on account of the facility of its use and the multiplicity of the formation gained at once, is highly appreciated by the French wine-makers.

To determine the sugar content of the grapes a few bunches are gathered, representing as near as possible the average condition of the crop, and the juice is expressed and strained through linen or cotton cloth, collected in a suitable vessel, commonly of glass, and

the must meter plunged into it. The quality of the must will then be indicated on the stem of the must meter.

The grapes are tested from day to day until the density remains stationary, when it is time, generally speaking, to gather the crop.

The must meter is not only of service in determining the richness in sugar of the grape juice, but is also employed to measure the fermentation and to determine when the sugar contained in the must has been entirely transformed into alcohol, as will be shown later.

The general rule to gather the crop when complete maturity is reached has exceptions. In south France it is frequently found advisable to gather the crop before maturity to augment the amount of acid, which is generally lacking in grapes grown in that region, or if the variety ripens at different periods the crop is commonly gathered when one-half the fruit is well ripened. If the grapes become over-ripe before gathered it is the custom to correct the composition of the must by adding a certain proportion of some variety yet partly green. The presence of the under-ripe fruit causes in the freshly pressed wine a slightly disagreeable flavor, which, however, corrects itself and disappears with the aging of the wine. Without these precautions the wines of the Midi are poor in bouquet and body and deteriorate rapidly.

The character of the wine which it is desired to produce or the variety of grape also act to determine the degree of maturity at which to gather the crop. Thus certain varieties, as the Muscat and the Malvoisie, are allowed to become over ripe to develop the characteristic aroma of the wines produced from them; and in the case of American varieties having a foxy flavor this objectionable feature is diminished by early gathering.

Time.—When it is possible to choose the most favorable time, gathering in the temperate regions is done after a succession of fair days and in the morning as soon as the dew has disappeared. A moderate degree of warmth also facilitates and hastens fermentation. In the very hot regions of southern France cloudy weather is preferable if rain does not fall, as moisture of rain or dew on the berries greatly prejudices the wine. In excessively hot countries, as in Algiers, it is recommended to gather the grapes early in the morning or late in the evening or at night, or at least to allow them to stand and cool over night before putting them into the fermentation casks.

The objectionable effect of the presence of dew on the grapes is stated to be not so much from the introduction of a certain amount of water, but in part from the introduction of germs floating in the atmosphere prejudicial to the wine, but chiefly because the grapes are too cold to enter readily into fermentation.

Instruments and Methods.—The instruments employed to detach the bunches are the curved knife used in pruning the vines, the ordinary pocket-knife, and small shears. The latter are considered

much preferable and are rapidly gaining in popularity. The use of the knife is objectionable because of its jarring the bunch and frequently causing more or less of the berries to fall off.

The grapes as gathered (and this work is commonly done by women and children) are collected in tin or wooden vessels of various forms, and in choice wine districts the greatest precautions as to cleansing of the utensils is taken, together with the apparatus used in the subsequent crushing and pressing of the grapes, to prevent the introduction of any foreign taste of wood or mold, etc.

The tin pails (Fig. 163) are preferred because they will retain the juice, which never fails to escape when the grapes are allowed to fall from any height, or when the vessel is overfilled.

The grape gatherers empty their vessels into large wooden tubs or receiving vats (Fig. 165), having a capacity of from 20 to 80 kilograms, and constructed in a variety of styles.

A grape-gathering force consists of the cutters or gatherers proper and the carriers. The latter receive the grapes in the larger vessels

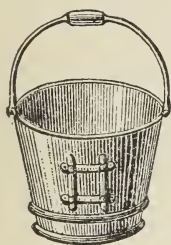


FIG. 163.—Pail used in gathering grapes.
(From Rougier.)

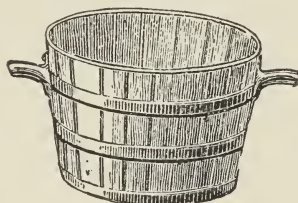


FIG. 164.—Receiving or carrying tub used in grape-gathering. (From Rougier.)

named, and sort them and transport them to the carts. They also oversee and direct the work of the cutters. In Bourgogne one carrier suffices for five cutters. In south France, where the yield is more abundant, the number of cutters to one carrier is reduced to three or four. In south France, also, the grapes are frequently emptied by the cutters directly into special carts.

In vineyards noted for their fine wines the sorting of the grapes is done with the utmost care as they are gathered either in the vineyard or at the cellar. In the former case the gatherers have special vessels to receive the injured, diseased, or unripe berries, or those soiled with earth or sulphur.

It was formerly more frequently the case than at present to gather the grapes at successive periods as they ripened. This method is now chiefly restricted to those noted vineyards which produce wines of such value that it is advisable to take every precaution in gathering and subsequent treatment to develop the special qualities of their wine products. Thus at Bordeaux the system of gathering is more complicated, and the maturity of the grapes at gathering varies

greatly in the production of the celebrated red and white wines of this region.

To obtain the rich, mellow, almost oily characteristics of the famous white wines of Sauterne not only are six or seven distinct gatherings made, but the grapes must be more than completely ripe, and in fact so dried by the action of the sun that almost one-half of their watery contents has been dissipated. The producers of the best wines of Champagne, Médoc, and Bourgogne use similar precautions, all of which is quite the opposite of the wholesale and somewhat careless methods of the Midi in the production of ordinary and cheap wines.

WINE MAKING PROPER.

THE CELLAR AND FURNITURE.—The building in which the must is fermented and the wine made is termed in France, as also in this country, a cellar. It is also commonly called a *cuvrie*, from *cuve*, a vat or tub. As temperature has an important bearing on the fermentation of the must, it is the important feature taken into account in the location and construction of the cellar. Effort is made to control the interior temperature and also protect the building from the changing temperature of the outer air.

In the Mediterranean region, and also elsewhere in France, the cellar is commonly constructed on a hillside in such manner that one side is in part embedded in and protected by the soil. This arrangement allows the grape carts to be taken directly into the upper or press room of the *cuvrie*. The building is still further protected from exterior heat by attached sheds and also by planting rows of trees about it. The use of double-storied buildings also greatly assists in the control of the temperature. In these the grapes are unloaded in the upper story and introduced through traps into the tuns or vats in the basement story. The control over the temperature is still further increased by constructing the buildings with double walls and by introducing the air for ventilation through flues opening at or below the surface of the ground. The dimensions of the *cuvrie* vary with the extent of the vineyard and the size of the casks employed. It is usually made three or four times as long as wide. The height of the lower room is that of the wine casks or tuns augmented by about one meter. The casks are commonly elevated 75 centimeters on supports, which would leave a space of 25 centimeters between them and the ceiling.

In the less heated regions of France, including the southwest, center, and east, it is frequently necessary to protect the wine cellars from too low temperature rather than too high. The same means are employed, viz, double walls, exterior protection, etc., and the openings are confined to the southern facade of the building.

In certain regions, particularly in south France, where the quan-

tity of the wine manufactured is of more importance than its quality, the cuverie is less carefully planned as to temperature regulation, and is more cheaply constructed, and consists commonly of a one-story, rectangular building of sufficient width to contain two rows of vats or tuns, with an alley space along the center to serve as a passageway for the grape carts. These structures are only employed in the manufacture of inferior wines, since being subject to the direct action of the sun and the hot air, the high temperature resulting within the building destroys much of the finer qualities of the grape.

The cellar furniture comprises the press, mills for washing and preparing the grapes, fermentation vats, casks or tuns, tubs used in pressing, the saccharometer or must scale, etc. These will be considered more in detail in the discussion of the several steps in wine making.

CUVAGE, OR FERMENTATION OF THE GRAPE ON THE HUSKS.—The term *cuvage* means the fermentation of the grape juice or must in connection with the skins or husks and other solid parts of the berry, and hence does not apply to the manufacture of white wines, in which the must is separated from the solid parts immediately after gathering. The making of white and other special wines will be treated after describing the methods employed in making the more important red wines.

The preparation of the grapes for fermentation in the manufacture of red wines includes a number of operations, all of which may sometimes be omitted. Thus the grapes may be thrown at once into the fermenting vats, or they may be more or less crushed, or, finally, the berries may be entirely separated from the stems and crushed before placing them in the vats.

The special treatments referred to are *foulage*, or crushing or mashing the grapes, and *égrappage*, or stemming or separating the berries from the stems.

Stemming.—*Égrappage* or stemming has been followed more or less from the earliest times, but is far from being generally practiced by French wine-makers. The stem when introduced with the must acts on the latter mechanically and chemically. The mechanical action consists in facilitating the access of air, and consequently the fermentation.

The chemical action arises from the stems imparting to the wine a considerable portion of the tannic acid which they contain and thus giving the wine a certain astringency which is of value to the wines of south France, which frequently lack in acidity, and is an objection to wines which are naturally acid or strong in tannic acid.

The variety of grape and the state of maturity of the crop are taken into account in deciding whether to practice *égrappage* or not. The proper course can only be determined by experience or by an analysis of the grapes in each region and for each variety of grape.

The following rules for égrappage are given by Rougier (*Manuel Pratique de Vinification*, p. 48):

In general the stems should be removed (1) when the grapes are very green; (2) when the variety is naturally very astringent.

The stems should be retained (1) when the maturity is much advanced; (2) when the grapes lack acidity, and when they contain a considerable quantity of mucilaginous matters, as in the case of those grown on very rich lands. The stems should also be retained whenever there is liability of incomplete fermentation.

The instruments designed to separate the berry from the stem are numerous and varied. For small quantities of grapes égrappage is accomplished by means of a trident, as follows:

Into a tub partially filled with grapes the operator plunges a three-branched rod or trident, which he causes to revolve rapidly. The berries are by this means detached and go to the bottom, while the lighter stems rise to the surface and are removed.

Another method followed for limited work is the use of an osier sieve with meshes sufficiently large to allow the passage of the berries and at the same time to retain the stems. The sieve or screen is placed above the vat or above the hopper of the crusher and partially filled with grapes, and by shaking it backward and forward the berries are separated and fall into the vat.

For larger quantities of grapes recourse is had either to the égrappoir or stemmer of Loyère & Gaillot or to the much more effective and superior rotating égrappoir recently devised and perfected by M. Gaillot. The latter only will be described. It consists of two instruments united into one; (1) a crushing mill placed on the upper part, which is provided with two cylinders, between which the grapes are passed; (2) the égrappoir proper, which is composed of a kind of box having for its base a semi-cylindrical sheet of copper pierced with holes of 30 millimeters diameter. In this box is a shaft provided with lateral arms arranged in the form of a helix. The grapes are emptied into the hopper, are crushed in passing between the rollers, and fall into the égrappoir. The movement of rotation frees the stems from the berries and juice, which escapes through the copper bottom, and the stems by means of the lateral arms, are carried to the extremity of the instrument where they are discharged. The work goes on continuously, one man being sufficient to operate the machine. From 70 to 80 kilograms of grapes are discharged per minute. If desired the crusher can be employed separately, it being possible to easily detach it from the égrappoir proper.

After passing from the cylinder the stems still retain a small quantity of must, which is extracted by pressing and is generally kept separate and employed in making vinegar. A mounted machine of this kind is shown at Fig. 165.

Crushing.—The crushing of the grape, or foulage, which consists

in rupturing the skin and expressing a considerable portion of the juice, when deemed advisable, is done either before or while the grapes are being placed in the fermentation vats. Foulage is ordinarily considered indispensable to the complete fermentation of the juice of the grape, but under certain circumstances it may be partly or entirely omitted and it has been found that the best wines of Bordeaux in years when the grapes reach their full maturity are made without foulage, and while being lighter colored, are distinctly finer in taste. Rougier, in the work already quoted, gives the following rules for foulage: (1) Complete foulage is useless in South France for thin skinned grapes which are fermented in casks. The partial crushing given them in placing them in the casks is sufficient. (2) Placing grapes in casks and crushing them after fermentation begins may be favorable in the case of incompletely ripened fruit.

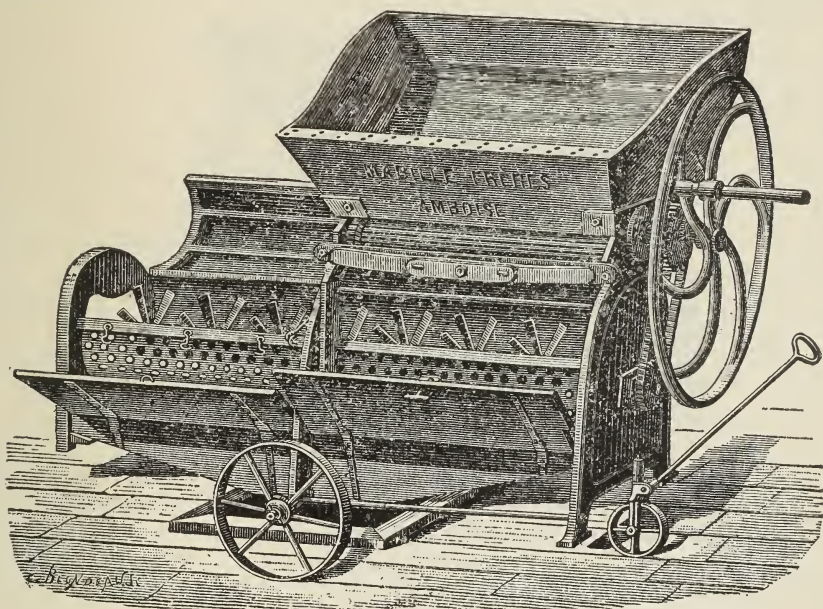


FIG. 165.—Mounted rotating égrappoir (Gaillet system). Mabille freres, Amboise. France.

- (3) In all other cases crushing probably ought to be practiced.
- (4) If crushing is practiced before the grapes are placed in the fermentation vats it is necessary for each locality and for each variety of grape to determine by experiment whether the crushing should be complete or partial.

Foulage is accomplished in various ways, including the traditional method with human feet, which last, while somewhat repugnant, is claimed to have certain real advantages. The weight of a man or woman is not apt to crush any green grapes that may occur, and especially the seeds, which it is very important to leave intact, as

they contain an oil injurious to the wine. The trituration of the skins is also better accomplished.

The foot method consists in tramping the grapes either with the naked feet or with wooden shoes—the former preferred—on special platforms, from which the liquid runs as fast as it is expressed. The operation is long and tedious and has, in a measure, been supplanted by the employment of machine crushers.

There are numerous makes of mechanical crushers used throughout France, but they are generally constructed after the same type, being practically identical with the form referred to in connection with the crushing *égrappoir* of Gaillot. They consist of a hopper beneath which work two grooved cylinders. The latter may be regulated as to distance of separation so that the crushing may be of any desired degree of completeness. The hollow cast-iron cylinders

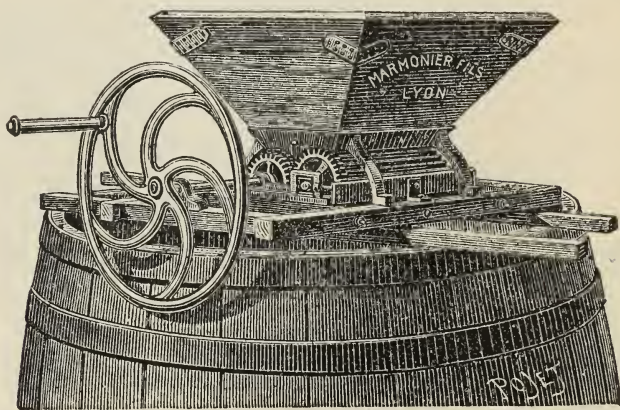


FIG. 166.—Simple grape-crusher. Marmonnier fils, Lyons, France.

now commonly used are preferable to wooden ones, the latter being apt to swell and warp or to be injured by the small stones or bits of wood that accidentally become mixed with the grapes. The crusher is frequently mounted on a simple frame so that it may readily be placed either directly above the pressing crate as in the manufacture of white wines or over the fermentation vat in the case of red wines (Fig. 166.) The grape-crushers are, however, ordinarily mounted, and the legs are frequently provided with wheels to facilitate transportation. This is always the case when the crushing is done in a room above the cellar proper, the grapes being discharged from the machine through openings in the floor into the fermentation vats below, as illustrated in Fig. 167, which represents a crusher of the form generally used in South France.

Foulage is sometimes accomplished after the grapes are placed in the fermentation vat as follows:

A man, naked of course, gets into the vat and breaks the grapes up with his body, hands, and feet, and thoroughly distributes the solid parts of the grape throughout the must. This method is not only exceedingly repugnant, but is accompanied with considerable danger to the operator by reason of the escape in large quantities of carbonic acid gas during fermentation. To avoid this danger the cellars are thoroughly aired and the precaution is taken to have an assistant near at hand. Tests with a candle are also made before entering the vat.

Foulage in the vats is also done with crushing sticks or pcunders consisting of a handle and an enlarged end with which the grapes are broken up and incorporated with the must. In the two methods

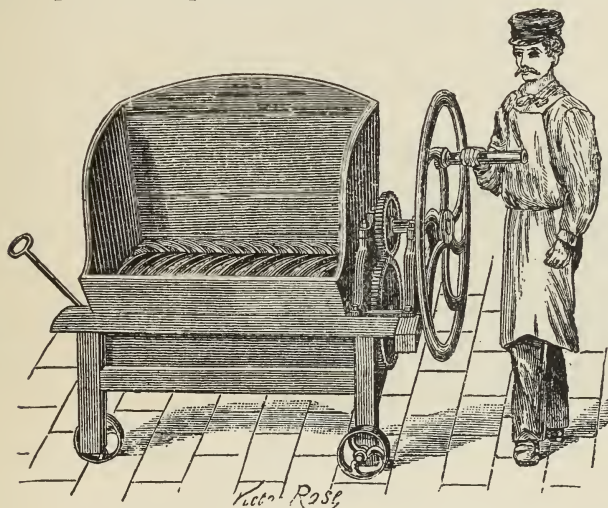


FIG. 167.—Grape-crusher used in South France. G. Pepin fils aîné, Bordeaux, France.

just described and where the human feet are employed the must is thoroughly aërated, which is not the case when the crushing is accomplished by means of the machines described above. Thorough aëration greatly facilitates fermentation and is very useful in certain cases, notably when it is desirable to obtain a complete transformation of the sugar into alcohol and to aid in the defecation or clearing of wines made from grapes too rich in nitrogenous matters. Aëration is also practiced in regions where the temperature is normally low and fermentation consequently proceeds slowly. To aërate the must suction and force pumps are sometimes employed to force the liquid must back into the general mass, which at the same time incorporates with the latter a good deal of air.

A machine for crushing the grapes and aërating them at the same time has been invented by Dr. Menudier and has given good success,

particularly in the making of white wines. The machine consists of a frame on which is mounted an iron cylinder (Fig. 168). The latter is the essential feature of the apparatus and is pierced by a shaft moved by a system of wheels and belts. The shaft bears six paddles and may be caused to revolve from 190 to 210 times per minute. The grapes are churned violently for from 15 to 40 seconds and are thoroughly broken up and aërated and a complete and rapid fermentation follows. In spite of the violence of the operation the skins and seeds, and even the stems, are rarely broken.

The cylinder can be easily filled and emptied, two men being required for this purpose.

Fermentation Vats or Cuves.—The *cuves* or vats in which the grapes are fermented are generally large tanks of oak or chestnut, having the form of truncated cones and resting on the larger base. Their capacity varies from 15 to 40 hectoliters. In the Midi of France immense cuves of masonry are constructed, the interior of which are lined with glazed bricks or more rarely with cement. In

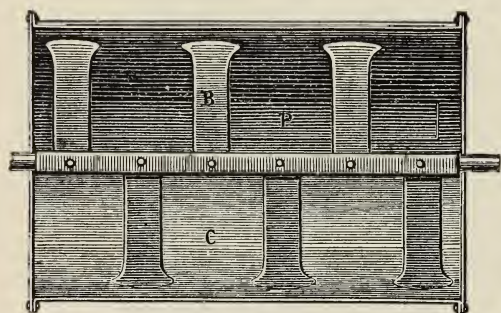


FIG. 168.—The Menudier crusher and aëerator. Section of the cylinder showing shaft and paddles. (From Rougier.)

point of economy and facility in cleansing these are superior to the wooden vats. Should it be desirable to elevate the temperature of the must, however, this cannot be done so easily in the case of cuves of masonry as with wooden cuves; but this objection is obviated in part by the former retaining the heat resulting from fermentation much more completely. In cold regions therefore the cuves of masonry are excellent to maintain the temperature necessary to regular fermentation, but frequently artificial heat must be employed to start satisfactory action. In the warm regions of southern France, however, they rather add to the defects of the wines by preventing the radiation of the heat of fermentation and maintaining a too-elevated temperature. As in the case of the cuves of wood they are made either open or closed. Before being used for the first time they are washed out with a weak mixture of sulphuric or tartaric acid in water to saturate the salts of lime and to prevent the latter from abstracting the acids from the wine. The cuve is then sponged out and filled with water, which after a time is drawn off and the cuve thoroughly rinsed. Cuves lined with cement are prepared for the grapes by rinsing them with a solution of silicate of potassium.

Vats of wood are especially adapted to the fermentation of wine, since, apart from certain resinous matters, they communicate no

objectionable taste to the wine. They are therefore always employed for all the finer and more valuable wines. A small quantity of air also passes through the wood and doubtless has an effect in improving the quality of the wine. A few of the many forms of wooden fermentation vats may be noticed, including the wine casks or tuns used for this purpose in South France, open casks, closed casks, and casks with stages or stories. The use, for fermentation tanks, of the smaller casks that are afterwards to contain the wine is generally followed in South France, where the great quantity, of wine produced makes it necessary to economize in methods employed. For that region and with grapes previously crushed or with very thin-skinned varieties this method gives excellent results and may be employed also in all regions where on account of high temperature the grapes ferment readily.

It is not possible to easily crush the grapes in these small casks, but in the regions where they are used this is not very essential, and if it should be necessary the grapes may be crushed and aërated before placing them in the casks.

There has been in France considerable controversy as to the respective merits of open or completely closed cuves, and the matter is still in dispute. It is admitted that while the oxygen of the air is essential to the starting of fermentation and that it accelerates the transformation of the sugar into alcohol, it will, when in contact with the alcohol contained in the chapeau or cap of husks raised by the fermentation, transform the alcohol into acetic acid and thus injure the wine. If, however, the precaution is taken to leave a sufficient space between the grapes and the top of the cask, the husks will not be raised so high but that the carbonic-acid gas, which is heavier than air, will form a protecting layer above them. The protection of the carbonic-acid gas can be depended on as long as the fermentation is rapid and tumultuous, and when the wine is drawn off immediately after such action, as in Beaujolais, there is no fear of injury by the formation of acids. Any inconvenience may, however, be avoided by pressing or submerging the husks beneath the liquid several times daily.

With the open casks also the grapes may be introduced without having been previously crushed, which in certain cases is desirable, as already pointed out. It is still further claimed for the open casks that the fermentation is more rapid and complete, and also that the wine is better colored, especially if the crushing and aëration of the grapes and must in the casks are repeated several times.

With closed vats there is little danger of the formation of acetic acid, since the chapeau is not in contact with the air, and when it is necessary or desirable to prolong the cuvage after active fermentation has ceased closed casks are used. The course of the fermentation is the same, but it is necessary to crush and aërate the grapes more

thoroughly before placing them in the casks, as this can not easily be done afterwards. The trap through which the grapes are introduced is raised during active fermentation, but should be closed as soon as such action stops, to prevent contact with air.

Prolonged cuvage is employed to transform the sugar completely into alcohol and to facilitate by long maceration the extraction of certain useful principles from the stems, etc., and also to develop the superior mellow flavor of fine wines. It has the inconvenience, however, to cause the loss of about one-eighth of the total quantity of alcohol in the wine, this amount being taken up by the stems of the grapes.

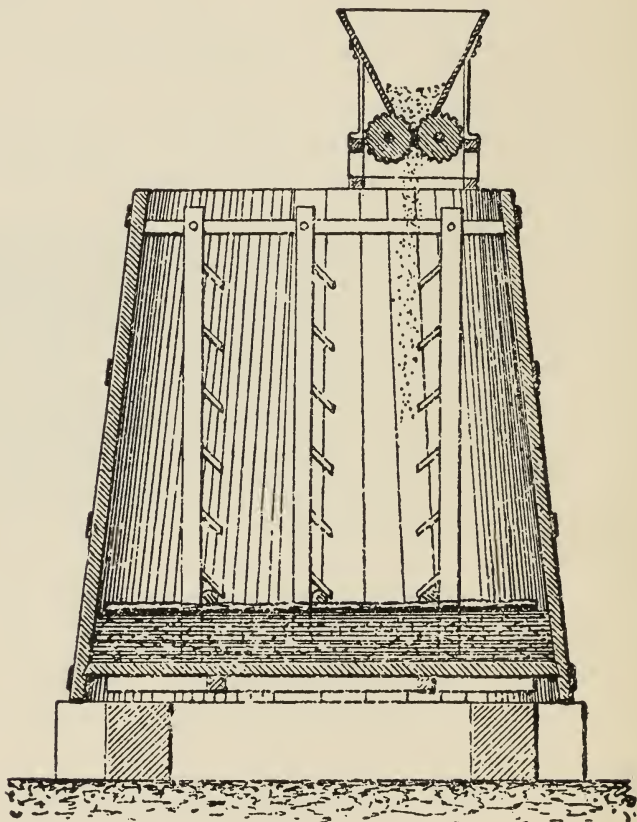


FIG. 169.—The Perret cuve. Vertical section, showing one of the transverse stages in place, and two of the vertical supports. (From Rougier.)

To avoid this loss, and at the same time to retain the advantages of closed cuvage, M. Perret has invented a cuve or cask with stages or stories by means of which the solid parts, husks, stems, etc., are held uniformly distributed throughout the liquid.

In a cask of ordinary form are fixed six vertical supports, which serve to retain in place the several stages or screens, as indicated in Fig. 169. The stages consist each of three main crosspieces and a number of smaller sticks arranged at right angles with the former,

and are put in place by means of a large opening in the top of the cask as the latter is being charged. The grapes, previously crushed, are introduced into the cask and divided into successive strata by means of the screens. A space of about 50 centimeters is left between the last screen and the top of the cask, and a little straw is placed beneath the superior screen to retain any detached grapes which might otherwise rise to the surface. By the action of the escaping gas the husks are raised and retained by each screen, and the liquid, by the inflation of the mass, soon rises and covers the entire series of screens.

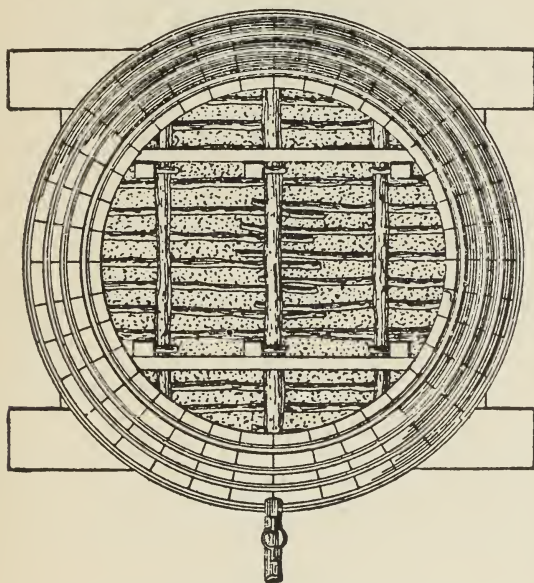


FIG. 170.—The same. Horizontal section, indicating the disposition of the sticks forming the screens. (From Rougier.)

It is claimed for this system that the distribution of the husks throughout the liquid facilitates fermentation, about six days only being required for complete action under ordinary conditions. This rapid action diminishes the amount of alcohol absorbed by the stems and at the same time, by reason of the thorough mixture of the solid parts with the liquid, the abstraction from the former of all the desirable elements is effected. The excessive formation of acetic acid is also rendered impossible.

This system of fermentation is highly recommended, and has been used successfully for twenty years in the central vine regions of France, where the richness of the must necessitates a prolonged cuvage and where the cold of winter frequently arrests the transformation of the sugar.

A system somewhat analogous to the above has been devised by M. Ferrague and used by him with good results. Its main feature

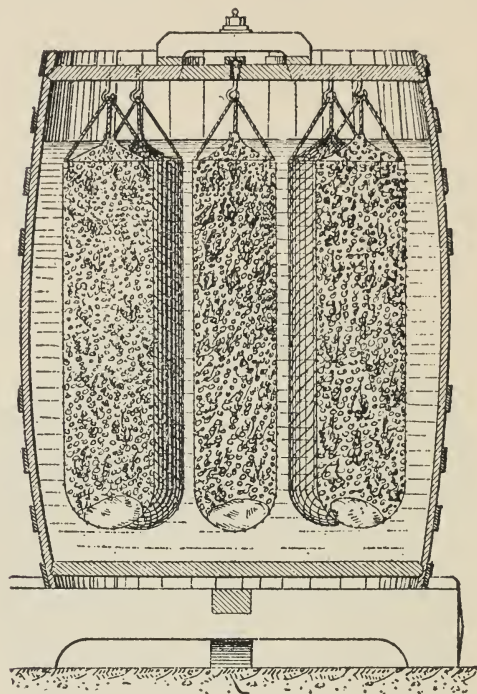


FIG. 171.—Ferrague cuve; vertical section.

consists in suspending the solid parts of the crushed grapes in the vat by means of coarse ramie-cloth bags, which may be easily removed after the wine is drawn off and obviates the necessity of

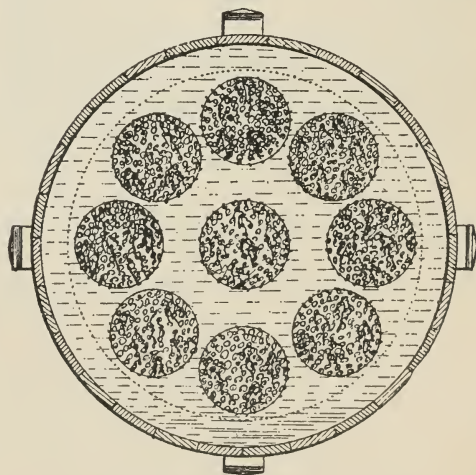


FIG. 172.—Same, horizontal section.

entering the vats to remove the residue. The details of the method are well indicated in the accompanying figures. (Figs. 171 and 172).

Relation of Temperature to Cuvage.—In the foregoing pages the influence of temperature on alcoholic fermentation has been referred to in connection with the subject of wine cellars and fermentation vats. The methods employed in France to control the temperature during the fermenting of the grapes remain to be pointed out.

The most suitable temperature seems to be between 15° and 25° C. At less than 15° the action is very slow and may be arrested altogether. Above 25° the action is too rapid and yet not complete, and flat wines without bouquet are produced.

This corresponds with the experience of American wine-makers, who have learned that temperature exerts a controlling influence on fermentation, especially in must, from late gatherings of over-ripe grapes. The must from such grapes frequently becomes what is termed "stuck," by which is meant the cessation of fermentation before the sugar is all converted. This difficulty occurs in dry, hot seasons, and with grapes having unusual saccharine strength, say exceeding 24 per cent. In Fahrenheit the temperature should be from 75° to 85° ; above 100° there is danger of acetic fermentation setting in.

Stuck wines which will contain from 2 to 10 per cent of unconverted sugar are almost certain to spoil ultimately, and unless it be deemed advisable to convert them into port wines immediate steps must be taken to reinduce the action of fermentation.

One of the best preventives for this difficulty is the use of shallow vats or cuves whenever trouble is feared. These should not be more than 3 or 4 feet deep, but may be from 10 to 20 feet in diameter, and if the must be frequently stirred or the liquid pumped back into itself, excessive heating will be prevented, and the consequent aeration of the mass will greatly hasten and facilitate fermentation. To lower the temperature, also, the French, in addition to the location and arrangement of the cellar previously indicated, sometimes adopt the expedient of directing a current of air through subterranean and moist passages into the lower part of the cellar or cause cold water to circulate about the casks by means of a system of piping.

Other means consist in reducing the saccharine strength by blending the over-ripe product with grapes poorer in sugar, or as a last resort pure water may be added as soon as the grapes are crushed—5 gallons of water being found sufficient to reduce 1 ton of must 1 per cent in sugar. Watered musts, however, yield wines of inferior keeping quality, and in which acetic fermentation will set in almost as soon as opened for consumption.

The same difficulty is avoided in California by drawing off the imperfectly fermented wine and adding it to the press wine. To this liquid is added freshly crushed grapes equal in amount to the quantity of stuck wine. By thus withdrawing a large percentage of the

pomace which generates the objectionable heat and supplying fresh material for fermentation, a new action will take place and probably proceed to a successful termination.

In general the more rapid the fermentation the better, although this will vary with the climate and variety of grape. In Bordeaux the action is usually completed in from seven to ten days, but in warmer regions in four to five days. If it is too slow or too much prolonged acetic fermentation will begin at the top, particularly with a floating cap.

In cold regions, however, the reverse difficulty is experienced, and it becomes necessary to adopt means of elevating the temperature of the must to start and maintain fermentation. The commencement of fermentation is also sometimes delayed by the cooling of the picked grapes or the pomace, or, in the case of white grapes, the expressed must, over night.

To obviate this difficulty arising from these or other causes the following means are adopted:

A certain quantity of the must is heated and poured directly into the cask, care being taken not to raise the temperature above 125° F., otherwise the germs of fermentation will be destroyed; or a more simple method is to insert in the must a cylinder containing burning charcoal. Dr. Guyot advises placing in the must a U-shaped tube through which steam is caused to circulate; quartz rocks also are heated and introduced into the vats for this purpose. In the case of cuves of masonry the walls may be heated before introducing the grapes, by means of a stove placed within the cuve. Ordinarily, however, the heat can be sufficiently regulated by closing or opening the windows and entrances or by a stove in the interior of the cellar. Fresh washed yeast is also used to start fermentation but is not recommended since it is liable to give an objectionable flavor to the wine.

DECUVAGE AND PRESSURAGE, OR RACKING THE WINE AND PRESSING THE HUSKS.—The duration of fermentation depends on a variety of conditions which have already been indicated.

In general the wine should be drawn off after active fermentation has ceased and when the saccharometer indicates that the sugar has been entirely transformed into alcohol, and finally when the temperature of the wine approaches that of the surrounding air.

It will be easily seen that the duration of the cuvage has an important bearing on the character of the wine, and its action in that particular must be studied for each variety of grape and for each locality.

Completely fermented wines are more delicate because of the smaller amounts of coloring matter and acids which they contain, while wines, that have remained for a long time in contact with the stems, etc., are more strongly colored and more solid.

In south France (Midi) the climate is so mild that fermentation

will continue after decuvage in the wine tuns, so that it is not essential in that region to delay decuvage until the sugar has been entirely converted into alcohol. In colder regions the transformation should be complete. If the fermentation has been incomplete a secondary action, known as *tourne* (turning), will take place in the following spring, which is attended with grave results to the wine, changing it in color from red to violet and giving it a disagreeable taste.

At the proper moment the wine is racked off or separated from the husks by means of a siphon or more generally a tap or spigot placed at the lower part of the cask. It is considered very important that the husks and lees should remain as short a time as possible in contact

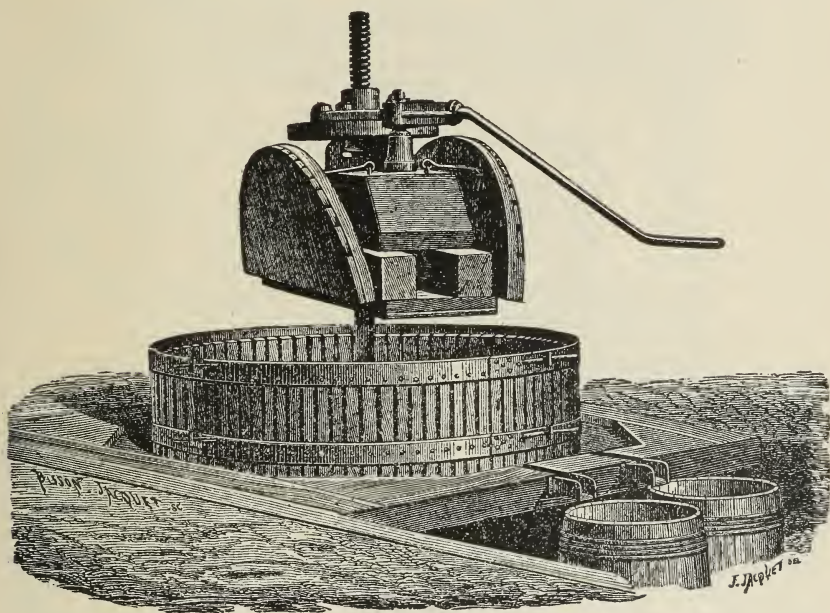


FIG. 173.—Mabilite Brothers' wine-press; ordinary type.

with the air after the wine has been drawn off to prevent the formation of acetic acid.

Pressing and Presses.—The styles of wine presses are very numerous and are either stationary or mounted to facilitate their transportation from place to place. The principal variations and novelties in these have been described in connection with cider presses under class 74. A few presses especially intended for use in wine-making may here be mentioned.

Fig. 173 represents a press of the ordinary type by Mabilite Brothers especially adapted for pressing grapes for champagne wines, and provided with a folding cover; it is also placed low upon the ground a space being dug away for the reception of barrels, etc., to catch the liquid as it issues from the press.

Fig. 174 represents a large press, made by the same house, and also especially for use in champagne wine districts. It rests upon a solid foundation of masonry, and is provided with a frame supported by cast-iron columns, and has a screw, worked by hand or by horse power, through the medium of a conical series of chain wheels, the pressure being rapid at first and then becoming slower and slower.

The presses described are of the common form and work interruptedly. A continuously acting press has been invented by M.

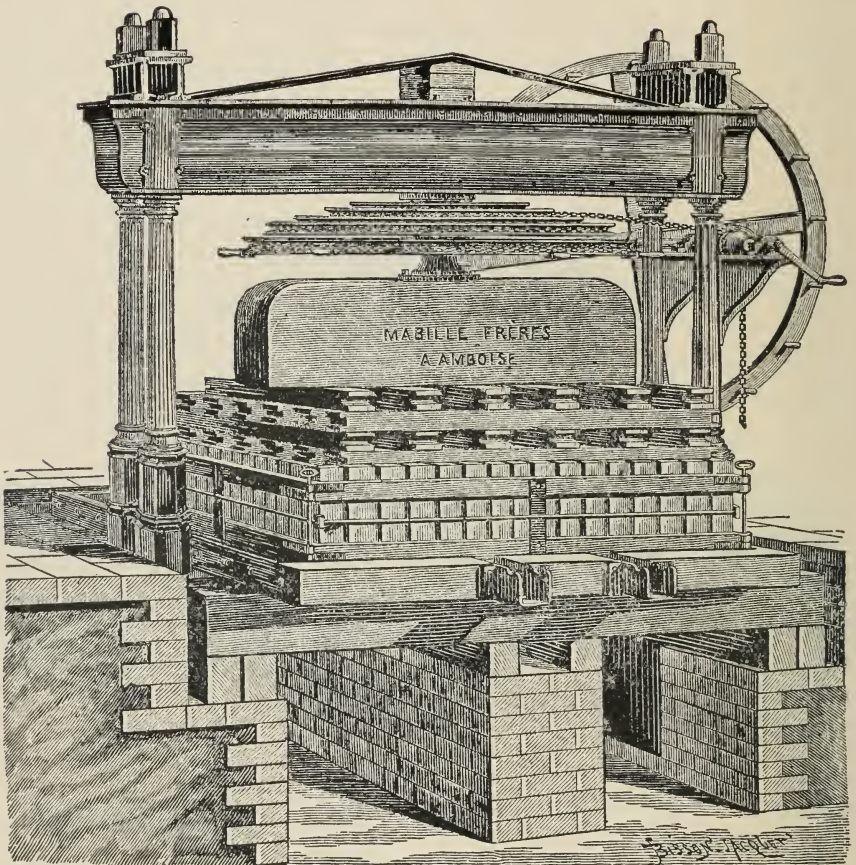


FIG. 174.—Same; large size used in the Champagne district.

Masson, of Lyons, by means of which more rapid work can be done and greater percentage of the liquid extracted. The press is composed of two cylinders, pierced with holes over their entire surface, and capable of being adjusted as to width of separation, and made to revolve in opposite directions. The husks and lees pass from the hopper onto two endless aprons and are carried by the latter between the cylinders. The wine passes through the aprons and into the interior of the cylinders through the holes in the latter, and is re-

ceived in gutters which conduct it to the discharge pipes. The aprons are freed from the husks by the action of two circular brushes which revolve in a direction opposite to the motion of the aprons.

These machines are constructed to be operated by hand, horse (Fig. 175), or steam power. From 400 to 3,000 kilograms of husks, etc., can be pressed per hour.

Press-wine and Cuve-wine.—The wine obtained by pressing the husks and lees has not the same composition as that drawn from the casks. The latter is commonly called cuve-wine and the former press-wine (*vin de cuve* and *vin de presse*). The cuve-wine is less acid and holds less solid matter in suspension. The press-wine varies greatly in composition and is generally divided into three lots. The first to run from the press is similar to the cuve-wine, containing, however, a little more alcohol, coloring matter, and acid principles.

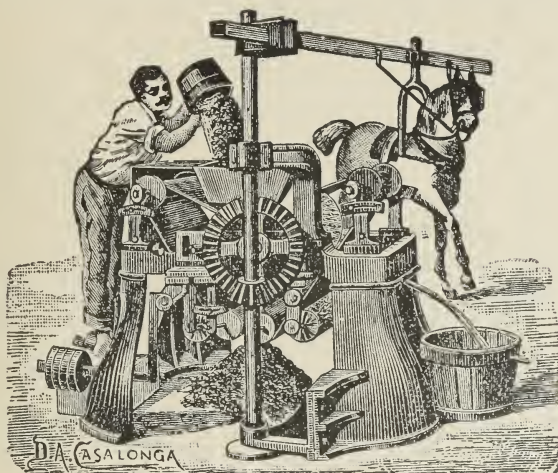


FIG. 175.—The Masson horse-power press. (From Rougier.)

The second lot contains less coloring matter and alcohol than the cuve-wine, but the proportion of acids is greatly augmented. The last of the press-wine is still more acid and astringent, and is also strongly mucilaginous and contains a considerable proportion of albuminous elements. It is seldom incorporated with the wine, but is used in the manufacture of vinegar or brandy. The first two lots are sometimes added to the cuve-wine to improve its keeping qualities. It is estimated that the cuve-wine represents three-fourths of the product and the press-wine one-fourth.

CORRECTION AND AMELIORATION OF THE VINTAGE.—In favorable years and under proper conditions the grape juice, without additions, will make perfect wine. Unfortunately this is seldom the case. Either the proportion of sugar will be too great or too little or the grapes will have to be gathered before fully matured, or they will be affected by fungous diseases, so that it becomes necessary to

correct the vintage in one or several respects. This is done by combining different varieties of grapes and by the addition of sugar, brandy or alcohol, plaster, tartaric acid, etc., and is legitimately done only to correct some natural defect in the must and not to fraudulently increase the quantity at the expense of quality. In this country the artificial correction or amelioration of the wine is frequently cried out against, although its necessity in certain cases is recognized by many leading viticulturists. In France it is practiced without question and the value of such treatment is universally recognized.

Combining different Grapes.—Reference has been made to the growth of two or more varieties of grapes in France in the same vineyard with a view of combining them to produce a suitable must. The varieties that may be suitably united and the proper proportion of each to use can only be determined by experiment and by testing with the must meter at the time of gathering.

Sugaring Wines.—Knowing that a wine should contain from 6 to 8 per cent of alcohol to pass through the summer without alteration, and from 9 to 12 per cent for long preservation either in casks or bottles, the amount of sugar necessary to be added to make up the deficiency in the must can readily be determined by testing with the must meter already described.

Crystallized cane or beet sugar when pure has the same chemical composition and the same properties as grape sugar, and produces by fermentation an alcohol of neutral taste identical with that produced from grape sugar. It should, therefore, always be used in sugaring wines. If too much sugar be added to the must the same inconveniences arise that occur in the case of grapes naturally too rich in sugar. The amount of sugar employed should not exceed the quantity required to give the wine 12 per cent of alcohol. The amount of sugar necessary to be added to the must having been determined, it is dissolved in must drawn from the cuve and poured over the cap immediately after the tumultuous fermentation has ceased and at the moment when the husks begin to sink in the liquid. The husks and must should be thoroughly mixed, repeating the operation several times. The sugar may also be added to the grapes from time to time as the latter are being filled into the vats, and this method is necessary if the Perret vat be used. In cold regions, however, it is the practice to put off the introduction of the sugar until the must has begun active fermentation.

The Addition of Alcohol or Brandy.—Alcohol or brandy are added directly to the wine to give to it the degree of alcohol which it lacks. This practice is especially common in all the fortified wines, and in fact most of these had their origin in the addition of alcohol to secure their preservation. The amount of alcohol is increased directly by the addition either of this substance or brandy, to the

cuve after the fermentation has nearly subsided. If added at the beginning of fermentation the action is checked. The use of brandy was formerly more general than it is at present, its high price in recent years having led to the very general use of sugar in its stead. Much damage has been done to the trade in European fortified wines by the use of potato and other cheap grades of alcohol for this purpose.

Watering Wines.—The ill effects arising from musts too rich in sugar have already been pointed out. In France this is rarely an inconvenience, because in the regions where this excess is apt to occur the grapes are utilized in the manufacture of sweet wines, a subject to be considered later on. When watering is practiced, however, the water to the amount indicated by the saccharometer is added to the grapes in the fermentation casks. With certain grapes rich in flavor and color both water and sugar are added without, it is affirmed, injuring the quality of the wine. Blending grapes or wines of different saccharine strengths is always preferable to direct addition either of alcohol or sugar, which at best produces a dry wine lacking in finer qualities, whereas by the other methods the fruity characteristics are preserved.

The use of Plaster.—Plaster or gypsum (sulphate of lime) is employed in the manufacture of wine in Italy, Spain, and in the Midi of France or in the warm Mediterranean regions. To understand the action of the plaster it is necessary to remember that the wine is produced by the action of a ferment or microbe—a microscopic organism which decomposes the sugar of the must into carbonic-acid gas and alcohol. After this action is accomplished the presence of these organisms in the wine will lead to secondary action which is very prejudicial to the quality of the wine. The salts of lime and particularly the plaster have the property of precipitating by a mechanical action these ferments and are of use to free the wine from them. In addition to its clarifying action the plaster retards and prolongs fermentation useful to the complete transformation of the sugar into alcohol, causes the formation of tartaric acid, and increases the color of the wine by reason of the longer action of the alcohol on the skins of the grape. The plaster is ordinarily added as the grapes are being placed in the cuve, and at the rate of 2 grams per liter of wine. The use of plaster increases the amount of sulphate or bi sulphate of potash, which in any considerable quantity is injurious to health, and its use in greater strength than that indicated is prohibited by law.

The use of plaster is not practiced, nor is it necessary in the colder central regions of France where the sugar is rarely in excess in the must, which latter is also richer in acids.

Tartaric Acid.—Tartaric acid occurs normally in the wine and is sometimes added to it in lieu of the plaster. As is seen, the plaster

tends to augment this acid and thus give stability to the wine. The use of this acid is confined to south France, where the grapes are generally poor in acid elements. It is added at the rate of 100 grams. to the hectoliter of must, either to the must in the cuve or to the wine in tuns, or a portion is added to the must and later an additional amount to the wine.

WINE-VAULTS AND WINE-CASKS AND TUNS.—The wine cellar described in the foregoing part of this chapter, or often common barns, are frequently employed in lieu of wine-vaults in south France in the manufacture of the cheaper wines. In the central region where wines of much finer quality are produced and where it is necessary to store it for a period of several years to develop its special features the wine-vault is indispensable.

The Wine-vault.—The vault differs from the cellar in that it is built below the surface of the ground, is arched over, and so arranged that the temperature can be maintained between 10° and 15° C. The vault should be kept aërated, neither dry nor moist. The air should enter from the north, circulating constantly, and should be pure and free from any tainting odor which by penetrating through the pores of the wood of the tuns would injure the wine.

In all the famous wineries of France the new wine is left in the cellar after having been drawn off from the cuves until the slight fermentation which usually follows has ended, the conditions for this action being better there than in the vault. The wine is then racked again and taken to the vault.

Wine-casks and Tuns.—The vessels in which the wine is stored after being drawn from the fermentation vats or tuns, casks, etc., vary greatly in size. Those employed for transporting wine have a capacity of about 5 hectoliters. Those of 215 to 228 liters, used in Bordeaux and Bourgogne are popular, on account of facility in handling. Tuns not intended to be moved from the vaults are sometimes of enormous size. The tuns and casks are commonly of oak or chestnut, with hoops of iron which has largely replaced wood, and when properly cared for last for a long period.

The capacity of the wine cask has a marked influence on the maturing of the wine. Thus it is generally recognized that with increased size of the cask the wine matures more rapidly and also after maturity deteriorates in a shorter period. The reverse is true in the case of small casks in which the wine rather tends to remain stationary. Large tuns or casks are used with safety in the storage of wines rich in sugar and spirit or when they are kept in fresh, well-ventilated vaults.

In the making of the best French wines the use of the old casks for new wine is avoided on account of the liability of such casks imparting an objectionable taste to the wine. Thus in Bourgogne and in Bordeaux new casks are always employed. The advantage

of new casks is incontestable ; the lees are deposited with greater facility and the fresh dry oak wood, well cleaned, is favorable to the preservation of the wine.

To cleanse and prepare new casks, in the larger establishments jets of steam are employed which are kept going until the water flowing out of the cask has no odor. Afterwards two rinsings with water are given, one with boiling water and the other with cold water, after which the cask is moistened with a small quantity of brandy. Sometimes common salt is added to the hot water to neutralize the acid principles of the wood.

To cleanse casks and tuns which have been emptied of wine, the lees and sediments are first removed and the casks are entered and thoroughly scrubbed out with a stiff broom, and then rinsed and dried. They are finally fumigated with burning sulphur. In the case of small casks that can not be entered, a chain scrubber is inserted with the water, and by rolling the cask back and forth the impurities adhering to the sides are loosened and washed off. Before filling them again it is a general custom to rinse them with a few liters of wine of inferior quality but good flavor.



FIG. 176.—Cleaning vats by steam. (Ergot, Paris, France.)

TREATMENT OF WINE IN THE VAULT.—If it be desired to mix the press wine with the cuve wine space must be left in the cask for this addition. The subsequent constant reduction of the volume of the liquid by the slight fermentation still going on and by the cooling of the liquid and also by its being absorbed to a certain extent by the wood of the cask necessitates frequent refilling of the casks, at first daily, then twice a week, and finally only once a month, and at less intervals with old wines. The importance of keeping the casks well filled can not be overestimated, as it prevents the development of noxious ferments. After fermentation has ceased the bung is loosely inserted, and four to six weeks after the wine was drawn off from the husks the cask is well filled and hermetically closed. It is important that the wine used in successively refilling the casks should be of the same sort, or at least of the same quality and age, as that in the cask, and a quantity is reserved for this purpose in small casks or in bottles. Small stones of silica well cleaned are sometimes inserted in the casks to make up for the loss

of the wine. In no case should alcohol or brandy be used for this purpose.

Racking Wine.—On being drawn from the cuve the wine lacks the limpidity and color which is afterwards assumed by reason of the presence of more or less of the skin, stems, etc., of the grapes. This solid matter induces still further slow fermentation.

Shortly after this fermentation ceases the wine begins to clear itself by the deposit of the solid matters held in suspension. A thick deposit forms at the base of the cask—the lees—and to prevent its becoming again mixed with the liquid the clear wine is racked or drawn off successively as many times as shall be necessary, oftener with fine than common wines.

No definite time can be assigned for the first racking, and no inconvenience arises from the wine remaining on the lees until warm weather begins. In France the wine is commonly first drawn off in March in the case of the finer grades. Common wines are generally racked in December. During the heated term of summer the wines are more or less agitated and additional lees are deposited, making it necessary to rack again, usually in August.

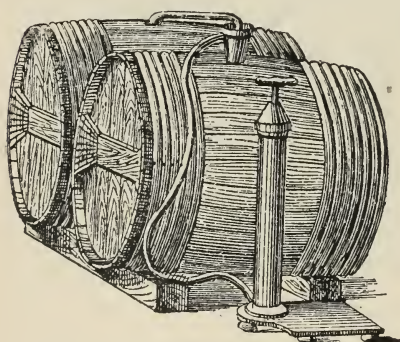


FIG. 177.—Racking wine by means of air pressure. U. Figus, Paris, France.

At the beginning of autumn and spring the changes of temperature influence and disturb the wine, and it is customary to rack it every year at these periods—March and September—until it is bottled.

The main precaution to be observed is to avoid as much as possible the aëration of the liquid unless it be desirable to hasten the maturation of inferior wines by rapid oxidation. Such aëration, however, causes the wine to lose both

bouquet and color. The worst method, and one only practiced in small operations, is to draw the wines into small vessels and pour it directly into the new or freshly cleaned cask. The wine is preferably drawn off by means of a siphon, or by connecting the full and the empty cask with a pipe the wine is driven into the latter by forcing air into the former by means of a bellows or air pump (Fig. 177). In all extensive wineries the transfer is made by means of suction and force pumps, by the use of which the liquid does not come in contact with the air (see Fig. 178).

Filtering and Fining Wines.—Even when racked frequently and with the utmost precaution wines are frequently still far from being perfectly limpid. Some wines will, however, after standing for a long period deposit the solid matter held in suspension, and ultimately clear themselves, and such wines are in taste, color, etc., superior to wine frequently treated with finings, which causes it to

lose more or less of the elements which impart to it the oily, mellow, and fruity taste.

When the wine remains for a long period (after the third racking) without clearing, or when it is desired to clear it rapidly in order to put it on sale at an early date, recourse is had to filtering or fining.

Clearing by filtration is seldom perfect and is accompanied by certain inconveniences, viz, it is a long and tedious process, and it exposes the wine to the air, causing it to lose bouquet, alcohol, and to deteriorate generally. In the later filters (*à manches*) this loss is guarded against somewhat by inclosing the filtering device in a copper receiver. The Vigouroux filter (Fig. 179) is one of the best of this type; it consists of (1) a superior receiver in which the wine is poured; (2) a series of cylindrical sacks of woolen, linen or cotton which are attached to holes in the base of the receiver; (3) of a larger receiver inclosing the strainers and from which a tube conveys the liquid back to the cask. The illustration represents the

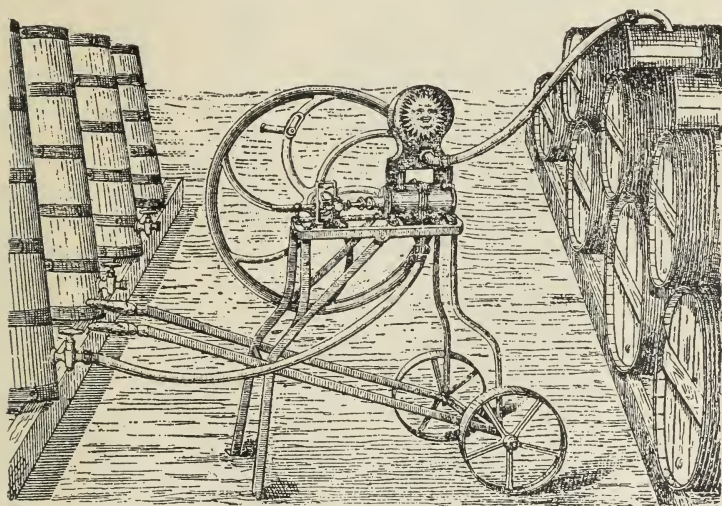


FIG. 178.—Pump used in transferring wine. Martin Frères, Augers, France.

method of using the filter, and at the right are shown entire and in section the cloth strainers employed.

By far the best and most important method of clearing wines, and the one very generally followed, is the addition of albuminous substances which the alcohol, acids, and particularly the tannin of the wine will coagulate and precipitate. For red wines the white of eggs is preferably employed because it does not precipitate the coloring matter of the wine. Sometimes common salt is added to the sizing, giving it weight and also preventing the decomposition of the lees.

With the use of white of eggs or beef blood the wine must be racked off after the action is completed; with the fish fining this is

not necessary, although it is generally advisable to draw the wine from the sediment as soon as it is cleared.

Among the mechanical agents are sand, kaolin, and paper pulp. The sand chosen is white and extremely fine and is washed carefully several times before being used. From 1 to 2 kilos of sand to the cask are employed. Pure kaolin exerts no deleterious effect on the wine and acts similarly to the sand. Care should be taken that the kaolin is not colored with the oxide of iron, which, while not particularly offensive in wine, is not a desirable addition. Preference should be given to white or slightly grayish kaolin.

The use of paper consists in reducing to a pulp unsized gray paper in a small quantity of wine and, when the paper is reduced to a thin, pasty condition, pouring it into the wine to be cleared.

With these three agents the wine is freed from the solid matter in

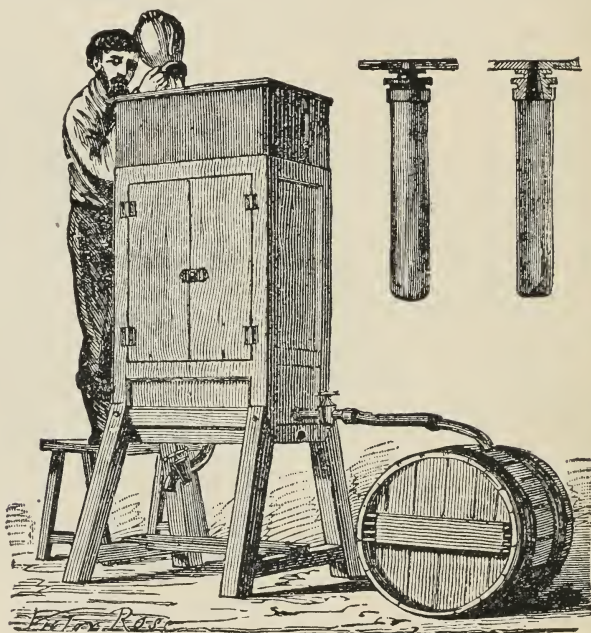


FIG. 179.—The Vigouroux filter. (From Rougier.)

suspension by these latter being carried down with the heavier solids through the liquid.

Among the clarifying agents which combine with the acid in the wine to form more or less insoluble salts are chalk, pulverized marble or shells, and plaster. The first three, which are nothing else than carbonate of lime more or less pure, combine with the acid elements of the wine to form lime salts, which, by their precipitation, act mechanically to clarify the wine.

The importance of the acid element in the wine, however, is so great, as has already been pointed out, that its abstraction by the use of these clarifying agents in excess may result in greatly injuring the

wine and bring about its decomposition or the precipitation of the coloring matter, etc. Even small quantities will, in particular cases, change an excellent product to a very inferior one. Plaster acts in much the same manner, and the use of these substances, particularly the former, should be in very limited quantity and is not particularly recommended.

There are two methods of sizing with the whites of eggs. In the case of the higher-grade wines the whites of five or six eggs are beaten up with a wooden beater and mixed with a small quantity of wine and the whole agitated thoroughly. The composition is then poured into the wine to be clarified and the whole thoroughly and violently agitated or stirred up. The tannin and alcohol, etc., of the wine precipitate the albumen of the eggs, and the solid particles in the wine are carried with the coagulated albumen to the bottom of the cask.

The second method differs slightly from the first and is employed in the case of the cheaper-grade wines. It consists in combining the whites of the eggs with a filtered solution of common salt, in which the former is more soluble than in pure water, while the salt is insoluble in alcohol. The eggs are beaten up as before and added to the wine, when the albumen and salt combine as a precipitate insoluble in alcohol and clarify the wine mechanically.

The common commercial gelatin is also generally employed to clarify wine. It is dissolved in hot water and added to the wine, forming with the tannin a more or less solid compound (tannate of gelatin) which acts, as with the substance already mentioned, to clarify the wine. With wine weak in tannin it is sometimes advisable to add 15 to 20 grams of tannin to the barrel to facilitate and complete the action.

The fish fining or isinglass, obtained from the air sac of the sturgeon (*Acipenser huso*), acts in the same manner as gelatin, and is preferred for the finer white wines on account of its greater purity. About 5 grams are taken for a cask (225 liters) of wine, and pulverized and macerated in a small quantity of wine, and allowed to stand for one day. A little tepid water is then added and the whole thoroughly mixed and broken up by hand, and then added to the wine.

The blood of animals is also used for fining, either entire or various portions of it, as with the fibrin removed or the serum alone. The latter only is recommended, as the coloring matter of the blood is objectionable. The serum is very much like the white of egg in composition and acts in a similar manner as a clarifier.

Milk is also used, but, like blood, is not to be recommended.

The best substance, therefore, in spite of its greater cost, is the white of eggs, except for white wine, for which the fish fining is preferable.

It sometimes happens that clearing proceeds very slowly, in which case the action is facilitated by adding 10 to 15 grams of tannin and 20 to 30 grams of tartaric acid per hectoliter of wine.

Fining is not always practiced in the case of red wine, except when it is intended to bottle it; with white wine fining is nearly invariably practiced.

Mutage, or Additions to Wine to prevent Fermentation.—Mutage of the French wine-makers consists in adding to the wine a substance which will prevent undesirable fermentation. The amount of alcohol contained in a wine determines the length of time that it may be safely kept. If the wine is weak in this element and it is desired to transport it a considerable distance, it is necessary to increase its percentage of alcohol. The addition of the latter has a similar effect to sugaring during cuvege and is practiced chiefly in the case of the weak wine of central France. The alcohol employed should be obtained from grapes, but the high price of this alcohol leads to the common use of alcohol obtained from grains, which imparts a special taste to the wine easily recognizable.

The same end is also accomplished by mixing wines, that is, combining wines weak in alcohol with others strong in that element. For this purpose the wine-makers of central France procure especially from Spain and Portugal strongly alcoholic and richly colored wines to mix with their own product, obtaining by this means solid, well-colored wines.

Weak wines are given stability also by burning a small quantity of sulphur in the cask. The sulphur fumes becoming incorporated with the liquid prevent the development of noxious ferments. A burning sulphured wick is introduced at the bung, and at the same time a small quantity of wine is drawn off at the spigot, leaving a space which is filled by the gas. The wick is then removed, and the cask closed and agitated vigorously until the gas is absorbed by the liquid. The wine drawn out is then poured back. Treated in this manner, the operation being repeated several times if necessary, wine will remain without alteration for a long period. The slight taste of sulphur acquired can be removed by aerating wine just before it is bottled for consumption.

SPECIAL TREATMENT OF WINES.—Wines destined to be transported long distances are submitted to special treatment to increase their stability. This consists either of congealing or heating the wines.

Congelation of Wines.—This consists in submitting them to a temperature below 0 Centigrade. The slight freezing causes a deposition of bitartrate of potassium, of coloring matter and nitrogenous matters. The wine is then racked and should be kept at 0 centigrade for one month, when it is again racked and the temperature brought up to the normal. This treatment frees the wine from the substances that would facilitate fermentation and has concentrated it by the loss of water in racking when slightly frozen, the percentage of alcohol being thus augmented. The freezing is either accomplished by removing the wine to open sheds in winter or by artificial means.

Chaufrage (Pasteurizing), or heating Wines.—By raising the temperature of the wine more or less, the various ferments contained in it are destroyed. This treatment is given more particularly to the higher grade wine and also to common wine intended for transportation. The wine may be heated in bottles or casks, or in special vats.

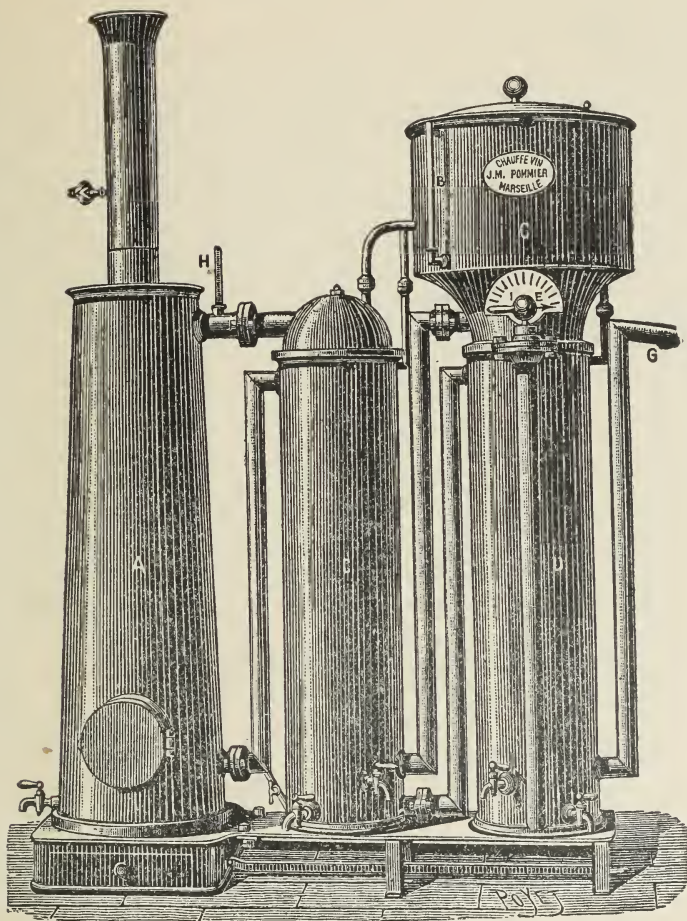


FIG. 180.—Pommier Wine-heater *Chaufrage-vin*. (From Rougier.)

The methods of heating wine as well as the appliances for the purpose are exceedingly numerous. In warm regions the wine is heated by the natural temperature, being placed in situations under roofs or shed, etc.; furnaces and even the heat of dung piles are utilized for this purpose. The duration of the operation depends on the degree of heat attained; at 30° C. a month is required; at 40–50° 8 to 10 days will suffice.

A much more scientific method is by the use of machines invented for the purpose by means of which the wine is raised quickly to a temperature of from 65° to 70° C., which temperature has been shown by Pasteur to effectually destroy all the ferments.

Of the many machines, space will be taken to describe but one, the Pommier apparatus sold by the society, L'Avenir Viticole, of Marseilles.

It consists of a reservoir C, of two cylinders DD, of a heating apparatus A, and of a system of piping for the passage of the wine. The wine is poured directly into the reservoir C, from which it passes through the stopcock E into the cylinders D. After passing through the cylinders it reaches the apparatus A, where it is heated; it is then conducted by special tubes into the interior of the cylinders D again, where it is cooled by its passage through the cold wine moving in the opposite direction. The temperature indicated by the thermometer H varies inversely to the rate of flow of the wine, so that by regulating the latter by the stopcock E, any desired temperature can be maintained.

The question of heating wine is still somewhat of an unsettled one, but the operation without doubt tends to the preservation of the wine, and is recommended particularly to arrest any fermentation or alteration that may have commenced.

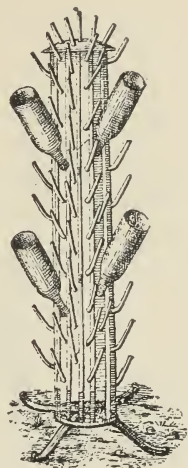
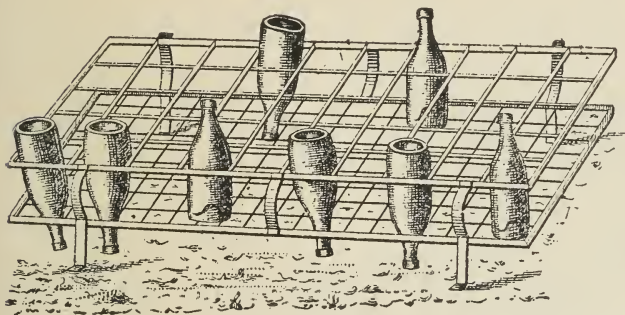
BOTTLING WINE.—No definite period can be given for bottling wines; they may remain in casks from fifteen months to four years or more. The common wines are disposed of at the end of the first year; the finer brands require a much longer time to develop their special qualities. As has already been noted, wine is constantly in a state of transformation, the rapidity of which depends on the size of the containing vessel. At a certain period it has acquired its maximum value and begins at once to deteriorate. By bottling, the wine is held in a state of almost complete quiescence, and having attained the best condition, will remain in that state for a long period.

The determination of the proper period for the bottling of the fine wines is an art and requires the ability to estimate, by taste, aroma, or bouquet, and color, the exact period when the wine has reached its best condition. If bottled too soon, the wine retains its green or partly matured condition, and if delayed much after the point of perfection is reached the resulting deterioration can not be corrected.

Before being placed in bottles, wines should have entirely completed fermentation, the excess of tartar, mucilaginous substances, albuminoids, and acids should have been removed, and the wine should be perfectly clear—that is to say, free from solid matter.

Bottling should not be undertaken for a month or six weeks after fining. The earlier that it is possible to bottle wine, the better will be preserved the characteristics of aroma, bouquet, and fruity taste.

The time of the year for bottling is still in dispute; generally March and September are the months chosen. Some noted wine-makers, however, prefer July.



FIGS. 181 and 182.—Racks for draining bottles. (Barbou fils, Paris.)

For the finer grade wines the choice of bottles and corks is most carefully made and considered of the greatest importance. In the case of the former it is found that the composition of the glass may exert a prejudicial influence on the wines—as, for example, the presence in the glass of a superabundance of alkali which will be acted on by the wine.

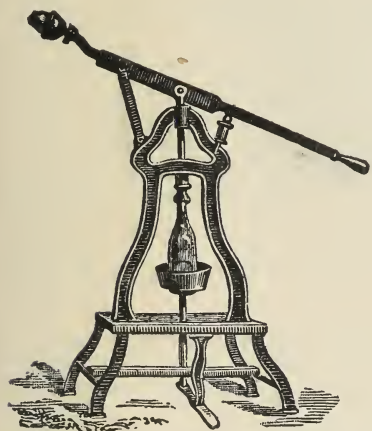


FIG. 183.—The Guillot corker. (From Rougier.)

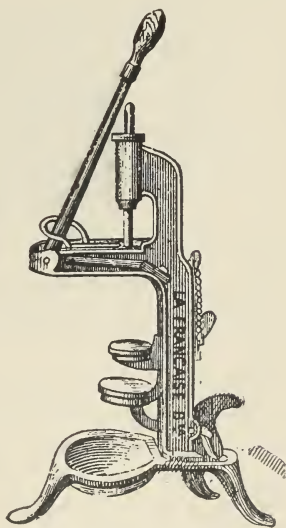


FIG. 184.—La Française corker. (U. Figus, Paris, France.)

The bottles to receive the wine are prepared with greatest care by being thoroughly washed and drained. The corks should be long

and of the best quality, and are well cleaned, and softened and tempered by soaking either in water or preferably in a small quantity of the wine that is to be bottled. They are inserted by hand or with a machine (Fig. 183 and Fig. 184).

If the wine is to remain long in bottles it is customary to protect the cork from the attacks of insects by coating it with a sealing wax of any desired color. The bottles are then stored in a cool place, not moist, but dark, to avoid the decoloration of the wine by the action of the light. They are placed in such manner, commonly on the side, that the cork will be completely covered by the liquid, and

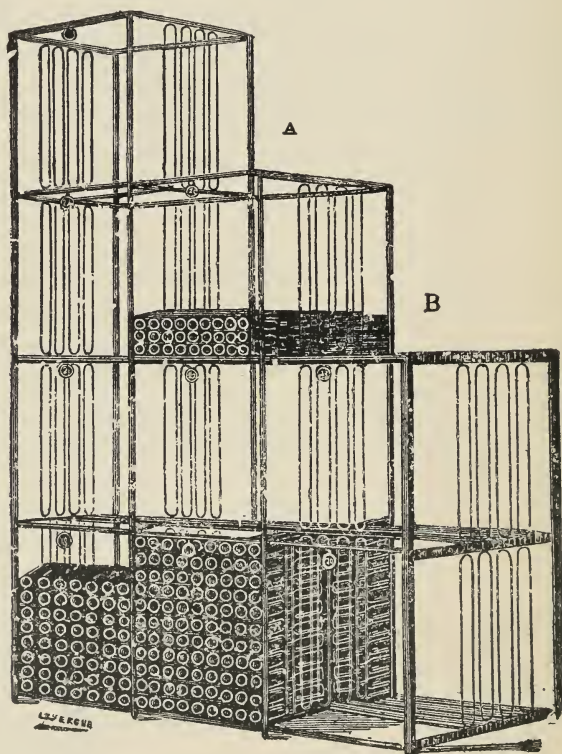


FIG. 185.—Rack for wine bottles. (G. Pepin fils, Bordeaux, France.)

are kept either in dry sand or on special racks of wood or iron (Fig. 185).

A deposit will frequently form in the bottles, making it necessary to decant them into other bottles, which should be slightly smaller than the first. Great care should be taken not to disturb the sediment, and to obviate the danger of this, various transferring devices are employed, of which common styles are shown at Figs. 186 and 187.

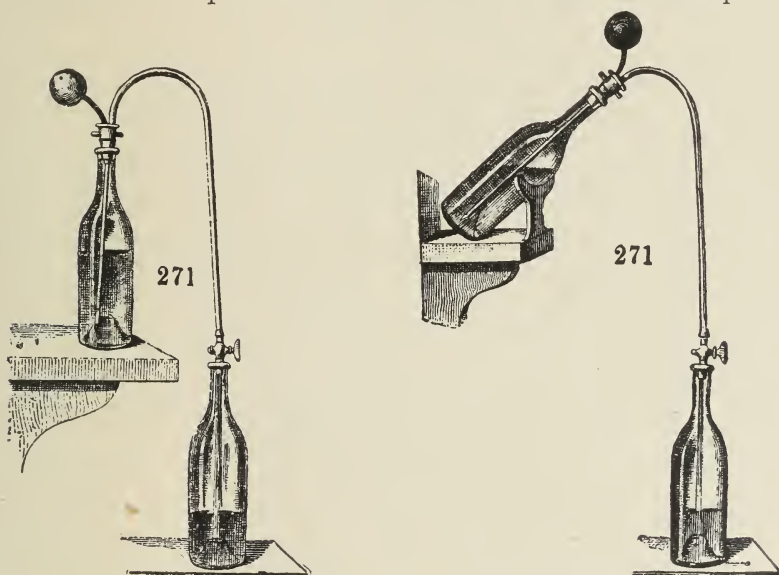
DISEASES OF WINES.—A few only of the leading maladies to which wines are subject are noted. In general, if proper precautions have

been taken in the gathering and manipulation of the grapes and must, no bad results need be feared.

Acid Wines.—The acidity of wines is due to the transformation of the alcohol into acetic acid under the action of the oxygen of the air and heat, and generally results from the exposure of the wine to the air for a longer or shorter period.

If measures are taken at the start the acidity may be corrected—(1) by racking into a well-sulphured cask; (2) by sizing repeatedly and thoroughly; (3) by adding alcohol; (4) by heating. It is difficult to entirely remedy the defect, and such wine is usually disposed of, consumed at once, or sent to the distillery.

Flat or turbid Wines.—This disease results from a decomposition which leads to a putrid fermentation. It occurs in wines poor in



FIGS. 186 and 187.—Decanting apparatus. (George Pepin fils, Bordeaux, France.)

alcohol and containing a large amount of albuminous material. The disease is remedied by transferring the wine to a freshly sulphured cask and adding alcohol. The wine should also be fined and after a few days from 25 to 30 grams of tartaric acid should be added per hectoliter.

Greasy Wines.—This occurs with white wine in casks and especially in bottles, and also, but to a less extent, affects the red wines. It is characterized by the production of oily and mucilaginous substances, which rise to the surface of the wine.

In general, wines weak in alcohol and tannin, produced from inferior or insufficiently ripened grapes, are subject to the disease. The addition of tannic acid, from 15 to 30 grams per hectolitre of wine, is effective in both preventing and remedying the disease. By agi-

tating the liquid the oiliness disappears temporarily, but to complete the cure the tannic acid must be added.

Bitter Wines.—The wines of Bourgogne are particularly subject to this affection. It first manifests itself by an insipid flavor which soon becomes bitter. The coloring matter alters also and precipitates to the bottom of the vessel. The change is due to faulty methods and to poverty of the wine in alcohol and acids.

At the start it may be corrected by fumigation with sulphur, as already described, followed with a vigorous fining. To remedy the composition of the wine, alcohol to the amount of 2 per cent is added, together with 10 grams of tannic acid and 50 grams of tartaric acid per hectolitre of wine.

SPECIAL WINES.

Having discussed the general subject of wine-making in France necessarily, however, in the briefest manner, it remains for me to speak of the principal special wines which do so much towards the establishing and maintaining the reputation of the country the world over for its wonderful vine products.

These special products are in white wines, rosy wines, foaming wines, sweet or liquorous wines, and less important but none the less interesting the wines produced from raisins or dried grapes.

WHITE WINES.—*Characteristics and Process of Manufacture.*—The white wines are made from the pure juice of the grape and from both white and colored grapes, the wine from the latter at first presenting a slightly reddish tint which afterwards disappears. Immediately after gathering the juice is expressed from either red or black or white grapes before any fermentation sets in and avoiding any maceration of the berries, and being fermented produces an almost colorless wine.

While the red grapes or a mixture of the red and white grapes are not infrequently employed in the manufacture of white wines the fact remains, however, that in all regions where the more famous wines of this sort are produced, white grapes are exclusively employed, and these are frequently allowed to hang long after ripening on the vines even until the leaves have fallen.

The utmost precautions are used in the gathering, sorting, pressing, and subsequent steps of manufacture with both red and white grapes. In the case of red grapes, which are gathered well ripened and all broken and fermented berries removed, the pressing is immediately and most carefully done with comparatively small lots and stopped the moment colored juice begins to flow.

In the case of the exclusive use of white grapes—the gathering is done during the warmer part of the day and during a dry period—the same precaution being used as in the matter of broken or fermented berries; for, little color as has the skin of the white grape, it

is nevertheless sufficient to impart under the action of fermentation a decided tint and flavor to the wine produced.

Previous to the introduction of the grapes into the press, in the more celebrated wine districts, as *Haut Médoc*, they are sometimes placed on an inclined table and submitted to a gentle crushing or treading under bare feet, which results in the securing of a small quantity of the juice of the grape, and from this is produced the famous wine for the year of that variety and vineyard. The grapes are then pressed in the ordinary manner, the resulting wine frequently being disposed of by the reputation of the first pressing. The must is put in casks which are left with the bung open throughout the period of fermentation, and afterwards submitted to the various treatments described for red wines.

This wine possesses particular properties by reason of its fermentation apart from the skin, stems, etc. The fermentation is slower and less heat is generated, which results in a smaller loss of alcohol and also of the various principles constituting the bouquet. The white wines in general therefore are stronger in alcohol and aroma than the red wines. On the contrary they are poorer than the red, in the principles coming from the skins, seeds, and stems, viz, tannic and tartaric acid, mucilage, etc.

The white wines are nerve stimulants ; their effect on the system is rapid but not lasting. The red wines on the contrary are more nutritive, hygienic, and more easily digested, and hence better adapted for general use.

The utensils—presses, casks, etc., employed in making white wine should be used exclusively for that purpose, or else should be carefully cleaned to remove all coloring matter.

The grapes being pressed immediately after being gathered and put at once in casks, the wine contains a large amount of albuminoids and is weak in acid principles. The albuminous matters come largely from the pulp, and instead of being deposited as in the case of red wines, remain longer in solution, owing to the feebleness of the liquor in tannic acid and the slowness of the fermentation. To hasten the defecation of these wines the temperature of the cellar for a portion of the winter must be kept at a point that will facilitate fermentation. The wine should be racked more frequently than in the case of red wines and preferably in the presence of air. The fining or sizing should be energetic, and to make it effective it is necessary to add from twenty to thirty grams of tannic acid per hectolitre.

The white wines are classified as *dry*, *sweet*, or incompletely fermented, and *alcoholic*. The liquorous white wines are treated in a special section later on.

Dry white Wines.—In these wines the sugar is entirely converted into alcohol, and the bouquet is at its maximum.

The method of producing this wine is not intricate, and is applicable only to wines naturally strong in alcohol. The pressing is somewhat prolonged rather than hastened, and the receiving vat is not entirely filled. The wine is then left without other treatment until May or June on the lees to accelerate and complete the fermentation (sometimes being drawn off in February), when it is ready to be bottled.

Sweet or incompletely fermented white Wines.—These are intermediate between the dry wines and the liquorous or fortified wines, and are made by checking fermentation before the sugar is all converted into alcohol. To arrest the fermentation it is necessary to practice *mutage* as soon as the wine leaves the press. The vapor of sulphur, as already described, is also employed. These wines should be preserved in cool cellars and may be kept fresh all winter.

Alcoholic white Wines.—These differ from the dry wines only in containing a larger proportion of alcohol, and are usually made in the warm parts of France where the grapes are rich in sugar and the heat facilitates fermentation. The natural maximum of alcohol in wines is from 14 to 15 per cent. A larger percentage is obtained by adding the alcohol directly to the wine. The addition is made after fermentation to avoid arresting that action.

SWEET OR LIQUOROUS WINES.—These wines, made from both white and black grapes, contain a certain proportion of unconverted sugar after the fermentation has ceased. They are produced chiefly in warm countries in which the temperature is high and the climate more or less dry, which induces in the grapes the formation of a very high percentage of sugar and a much more marked aroma than is found in grapes grown in cooler climes. These wines, while produced largely in the south of France, are more familiarly associated with Spain, Portugal, the Mediterranean countries, and the warmer portions of southern Europe. Of this class are the wines of Malaga, Madeira, Candia, and the unexcelled Tokay wines of Hungary. The necessity for a high percentage of sugar in the grapes leads to the postponement of the vintage for as long a period as possible in order that the grapes may lose by evaporation a large portion of their water contents. By this means the sugar undergoes a certain transformation also, which seems to act very favorably in the production of the desired qualities in the wine. Wherever this natural ripening on the vines will produce the requisite amount of sweetness, the best liquorous wines can be produced. In more northern regions, however, the same end is reached by artificially drying the grapes. To produce a good wine of this class, the must should indicate at least 20 per cent when tested with the glucometer, or in other words sufficient sugar to develop by fermentation 20 per cent of alcohol, of which the mature wine will contain in the neighborhood of 15 per cent and the balance will be free sugar. This results in the for-

mation of a wine which is at once alcoholic and sweet or what is termed liquorous. In the case of grapes again, in very warm regions, which will acquire naturally sufficient sugar, the only precautions necessary are to secure sufficient evaporation to bring the sugar to the proper percentage. This is accomplished by removing the grapes and allowing them to evaporate some of their water under the action of the sun and air. Usually a reduction of about one-third in weight by evaporation will be sufficient for the purpose and will be secured after an exposure of five or six days. The grapes are then carefully sorted and subjected to a slight crushing, after which they are pressed and the must is stored in small barrels, in which the bung is inserted loosely so that the beginning of the fermentation can be observed. The action is checked by removing at frequent intervals the cap raised by fermentation, thus withdrawing from time to time a considerable portion of the active element of fermentation and preventing the complete transformation of the sugar into alcohol. The liquid is then carefully drawn off and filtered, the operation being repeated several times until all fermentable matter is separated. If the weather is such, on account of excessive rains or otherwise, as to prevent the natural drying of the grapes on the vines, this is accomplished under protection or by means of special evaporators or drying ovens.

The process outlined above results in the production of the best liquorous wines. Any other process which will result in securing the desired percentage of sugar by artificial means is applicable to regions which are less favorable to the production of sweet grapes. In colder regions after having ripened as much as possible on the vines or up to about the time of the first frost, the grapes are gathered in the warm dry days and separated out on beds of straw, or, better still, are suspended in the air, either by the stems or preferably near the tip of the bunch, so that the grapes will separate from the stem and allow a more ready passage of the air and evaporation. When hung up on wires, in the manner last described, the evaporation is somewhat more rapid than on straw. As soon as the evaporation has gone far enough to bring the concentration wished, the grapes are carefully separated from the stem and sorted, crushed in small lots, and reunited in large tuns, to remain about twenty-four hours or until the commencement of the fermentation. The wine coming from the press is usually divided into two lots, the first of which is softer and more agreeable in flavor than the last, which is inclined to be more alcoholic and somewhat astringent. The marc, which still contains a considerable amount of sugar, is employed in making cheap wines, and is frequently used to add flavor to and increase the percentage of alcohol in inferior white wines. This somewhat artificial process of making these wines is very similar to that employed in the celebrated vineyards of Tokay, the difference being

that in Tokay the grape ripens so early and the dryness of the climate is such that the drying of the grapes takes place on the vines instead of under artificial conditions.

The description given above relates only to white grapes. With black grapes the process is the same up to the point of crushing the grapes. At this step they are placed in barrels which are two-thirds or more filled. The bungs are closed with tapering plugs so that it is possible for the passage of the gas arising from the fermentation without allowing the exterior air to enter. When the fermentation is nearly finished and the liquid has assumed a good color, it is drawn from the barrels and to it is added the juice obtained by pressing the marc, the latter giving it additional color and force. The fermentation now continues to completion, when the liquor is carefully drawn off.

There are still other methods of artificially producing the required amount of sugar in grapes. One of the oldest is that given by Columella, which consists in subjecting the grapes to the action of ash lye which has been carefully filtered. This causes them to evaporate more rapidly. Another method, which, however, is not recommended, and is not employed by the best wine-makers, consists in concentrating the must by boiling it in immense vats until it has acquired the desired density. It is usual to continue this until the density has reached 30° Baumé and then a sufficient quantity of non-reduced must is added to bring the density down to 20°.

In addition to the wines of this class, which are produced in favorable regions there are others made from grapes grown in comparatively cold climates or of grapes the ripening of which from other causes has been retarded. The methods employed are more artificial and the product is inferior. Preferably grapes are chosen which are naturally as sweet as may be, and which have considerable natural aroma, such as the Muscats and others of that category. These are gathered at as late a period as possible and are subjected to the drying process already described. To obtain the desired consistency, 18° to 20° Baumé, the must is boiled, and as soon as sufficiently concentrated is clarified with white of eggs beaten up with the liquid. When nearly perfect limpidity is reached, the whole is brought together in a large tun or tank and subjected to the treatment outlined above in the case of the other wine. Should the bouquet or aroma be insufficient, a suitable perfume or aroma is added artificially. In most vineyards, however, only a portion of the must is reduced by boiling and the reduction is carried to a point beyond that necessary if all were subjected to this action, and the normal density is secured by combining the reduced with the unconcentrated must. If the grapes are not sufficiently sweet, in some cases sugar is added directly to the must, or more frequently alcohol is added to the vats before the fermenta-

tion is complete, which arrests the fermentation and leaves in the wine some of the natural sugar unchanged.

ROSY WINES.—These are known in France as *vine rosés* or *vins d'une nuit* (wines of one night), the latter phrase indicating the nature of their production.

They are made from red grapes of which the must has begun fermentation in the presence of the pomace. A portion only of the coloring matter is dissolved by the action of the alcohol, giving a slight tint to the wine. The liquor is drawn off after twenty-four hours or sometimes two days, and the subsequent treatment is the same as for white wines, which they approach in composition.

CHAMPAGNES OR FOAMING WINES.—The foaming or sparkling characteristic of certain wines is due to the presence of carbonic acid which they contain in solution and which when the wine is uncorked escapes and occasions an effervescence or foaming. In other respects they do not differ from other wines.

The interest attaching to these wines and their importance will warrant a fuller description of the methods of manufacture.

Wines of the Province of Champagne.—A more highly appreciated or celebrated wine than the foaming or sparkling product of the vineyards of the province of ancient Champagne is produced nowhere else in France or in any other wine-center of the world. This province belongs to the department of Marne and includes the districts of Rheims, Épernay, and Châlons. It has an area of vineyards of something more than 14,000 hectares, which, however, by intensive-culture methods is made to yield its utmost.

The broad fertile plains of Champagne, thanks partly to the superiority of the variety of grapes comprised in their vineyards, partly to peculiarly favorable climatic conditions, and also to character of soil and careful system of cultivation, have from time immemorial, almost, been famous for the flavor, bouquet, and freshness of their wine products. The praise of their red and white wines began to be recorded as early as 530 A. D.; but it was not till toward the close of the Seventeenth century that the foaming wines which have taken the name of this famous vine region began to be produced.

Discovery of foaming Wines.—Legend attributes the discovery of the method of producing sparkling wines to a certain Dom Pérignon, a prior in charge of the wine vaults of the Abbey d'Hautvilliers, near Épernay, and it was not long until the production of ordinary wines was abandoned in favor of the more celebrated product.

This discovery, doubtless accidental, was that by bottling the wine before fermentation had ceased, the subsequent transformation of the sugar in the liquid generates a quantity of carbonic-acid gas which is held in solution, but escapes with effervescence when the bottle is uncorked. For a long period after this discovery the only

way of determining the amount of sugar in the wine at bottling to produce the proper effervescence was to judge by the taste. The exact amount of sugar required for the best results is now known and apparatus for its accurate estimation are now in general use.

Variety of Grape.—Foaming wines may be made from the product of any vineyard of any region; but, favoring conditions and the benefit of traditional experience having given the first rank to the wines of Champagne, it is eminently proper to describe the processes employed in this department in preference to those of other regions.

On entering this famous district at harvest time, one is at once struck by the fact that, contrary to the natural supposition, more red grapes than white are grown and used in the making of Champagne and in fact the proportion is about three of the former (the *Pinot rouge* predominating) to one of the latter. The precautions employed in gathering the crop and expressing the must result, however, in obtaining an almost colorless liquid, which becomes nearly perfectly so after the first fermentation.

If the white variety be used alone a fine, light, fresh wine is produced, which is, however, usually too acid; the black or red grape, on the contrary, produces a white wine less acid and with more body, but somewhat astringent and of better keeping quality. By combining the two grapes in the proper proportions the quality of must best suited for foaming wine is secured.

Gathering and Pressing and Treatment of Must.—It is difficult to appreciate from our standpoint the extraordinary care used in gathering the ripened fruit and in sorting out all bruised or in any way otherwise injured berries.

Pressing follows immediately after gathering without allowing the grapes to become heated by the sun and before the least fermentation has set in, the greatest cleanliness being maintained about presses and receiving tuns for the must. The presses are large, having a capacity of about 4,000 kilograms of grapes or about 40 of the willow paniers used in transporting the grapes from the vineyard. (See pp. 389–390 and Figs. 173 and 174.)

The first liquid to come from the press known as *vin de choix* or *vin de cuvée* is kept apart and constitutes the source of the best champagne; the subsequent product is divided again into second and third lots, which latter, in the case of the more celebrated vineyards, are employed only in the manufacture of inferior and non-foaming wines. In other and less noted vineyards the results of all the pressings are put together and made into champagne. The second and third products need not be followed, as the further steps are the same as those already detailed. The *vin de cuvée* is allowed to rest for ten to twelve hours in a well-rinsed cuve or in casks, to allow the coarse lees and any other solid particles to settle to the bottom. When this has taken place the must becomes covered with a whitish

blanket, which indicates the beginning of fermentation and the commencement of the escape of the carbonic acid with which the liquid is now saturated. To further check this action, the liquor is at once drawn off from the heavier sediment into casks of about 200 liters capacity, which have been previously very carefully cleaned and sulphured to remove or destroy any germs of decomposition which they may harbor, care being taken, however, not to fill them until the fumes of sulphurous acid have nearly all escaped; otherwise the desired fermentation in the introduced liquor would be more or less completely arrested. When filled the casks are arranged in the cellar on supports or benches to remain untouched until January or February, except that, immediately after being stored, an addition of sirup composed of wine in which has been dissolved 500 grams of sugar per liter is made to insure in the wine after fermentation a percentage of alcohol between 10 and 11.5 to 12. The amount of sirup to be added must be determined by the must-meter and will vary with the maturity of the grape, its richness in sugar, or the demands of the market.

An excess of sugar will result in a greater strength of alcohol and if this exceeds the maximum of 12 per cent the germs of ferment are smothered or held inactive and the wine will fail to develop its foaming character, and this result has been brought about on several occasions by the natural but excessive sweetness of the grapes in particular years, notably in 1865, on account of peculiar climatic conditions leading to the development of an unusually large percentage of sugar in the berry. After the addition of the sirup 5 or 6 liters of the must are drawn from the casks by means of a siphon, to give space for the action of fermentation, and the bung is covered with grape leaves held in position with a piece of tile, so that the escape of the carbonic acid may take place without affording opportunity for the entrance of germs of decomposition from the atmosphere.

At a temperature of from 12° to 22° C. fermentation readily takes place and reaches its maximum and almost entirely subsides again in from five to eight days, the casks being filled up a little at a time as the action subsides.

The liquor or wine has now assumed a milky color and is allowed to stand for fifteen to twenty days, after which the casks are completely filled and the bung inserted, a small hole being made in the superior stave of the casks in which straws are inserted to permit the gas to escape without affording entrance to deleterious germs.

Winter Treatment—Combining Wines.—By January the coarse sediment of salts and organic matter has been precipitated by the action of the cold, and the wine has become limpid and ready to be racked off into clean casks. A small quantity of alcohol is added at this stage to make up the amount lost by evaporation during the

racking and transferring of the wine. During the months of January and February the different products of the vineyard, or, in the case of wine syndicates, comprising a large number of vineyards of the province, the products of all these "crus," are brought together to be thoroughly incorporated one with the other in wine tuns or vats of enormous capacity.

Experience has demonstrated that to obtain a perfect wine it is necessary to combine the new wine of different varieties of grapes or from different vineyards or, better still, provinces and also to mix the product of different years, by means of which the character of the type of the output is maintained uniform from one year to another, or the changes are so slight and transitional as to be imperceptible to the consumer.

This combination is one of the most important steps we have yet reached and for it rules or specific directions can not be given. The expert taster estimates the quality of bouquet, astringency, acidity, etc., of each cask and determines the amount or proportion of it which should be combined with other products or different varieties, vineyards, or years to produce the typical wine, and ability in this is only the result of long experience.

When the whole has become harmonized and homogeneous and ameliorated by combining one with the other, the wine of that year is practically formed and only needs, to be prepared for the market, the subsequent and yet important manipulations described below.

Treatment with Tannin and Fining.—In the case of the foaming wines it is even more important than with the others to remove at this stage any elements, such as organic matters, gelatinous or albuminous, which would induce a series of changes in the wine and cause it to deteriorate or be affected by various wine diseases. The addition of tannin renders these dangerous elements insoluble and removes, for the most part, the possibility of their inducing any alteration in the wine. It is, however, liable to leave the liquid more or less astringent and affects, to a certain degree, the softness and mellowness of the wine. Hence the addition of tannin should be made with some care, and the amount usually employed in champagne wines varies between 5 and 10 grams of the pure article to each barrel of the capacity of 2 hectoliters. It is, nevertheless, necessary to have a certain excess of tannin in the wine after fining, to prevent the slight precipitates, which will occur after bottling, from adhering to the bottle. It is also sometimes necessary, and in fact is the usual practice, to add a small amount of tartaric or citric acid at this time. The transference of the wine from the smaller casks to the immense tuns in which the different products are thoroughly incorporated, results in a certain loss of alcohol by evaporation, and this must be made good by the addition of an equivalent amount of pure alcohol, care being taken, however, not to bring the percentage

of alcohol above the amount already given, viz, 11° to 12° . The thoroughly homogeneous product is now again drawn off into small casks to undergo the process of fining, which is similar in the case of these wines to the methods already described, except that in the case of champagne wines the fish fining only is used. The method of fining these wines is of interest, and is thus described by M. Salleron :

In a small wooden vessel or barrel about 250 grams of isinglass, broken into small pieces, are placed, and to this wine is added from time to time to the amount of 20 liters, the mixture being meanwhile violently agitated with a rush brush. This mixture is then allowed to stand for three or four days, and, when the fining is thoroughly dissolved in the wine, the whole is drawn off into a small barrel and vigorously agitated while about 80 liters of old wine are added, a little at a time. The resulting sirupy mixture is added to the wine to be fined in the proportion of 2 liters to 200 liters of wine. The barrels containing the wine are then agitated violently by striking them with a mallet to cause the fining to penetrate throughout the entire mass of the liquid. After this operation the barrels of wine are removed to the cellar and after the fining has settled they are racked off and resized two or three times, following the same methods. At the opening of spring, or about the time the sap begins to circulate in the trees, the wine, influenced by the elevated temperature, begins to undergo a slight fermentation, and this indicates the period to begin the process of bottling.

Racking.—The wine, which during the winter has been carefully fined and clarified in the wine caves and kept free from deleterious ferments and germs by frequently filling the barrels, is now racked off for the last time to remove from it the various organic matters which have been separated by the addition of the fining, and to free it from the larger part of the elements of fermentation which have been carried down in the sediment. Care must be taken, however, not to rack it so carefully as to obtain a liquid entirely free from the germs of fermentation, as this would result in a wine which would not produce any of the foaming characteristics of the champagne wines because lacking the small element of fermentation necessary to produce the action in the wine after bottling. It is necessary, therefore, in drawing off the wine to have it slightly troubled or clouded from the removal with it of a small portion of the sediment containing the germs of fermentation. To be assured of the presence of sufficient spores of fermentation, it is customary to make a microscopic examination of the wine, and if the racking has been done too carefully and the wine does not contain enough of the ferment, some wine containing a considerable quantity of the ferment is introduced in each barrel. A certain aëration is also necessary to bring about this subsequent fermentation, but the necessary amount

of oxygen will usually be taken up by the wine during the process of racking and the subsequent bottling.

Sugaring.—The necessity for the addition of a small amount of pure cane sirup to the wine previous to bottling, to insure the production of carbonic-acid gas by subsequent fermentation, has already been referred to, and the amount to be added is a matter of very considerable moment, varying with the amount of native sugar in the grape. If too much sugar be added the production of the gas will be so great that an excessive percentage of the bottles will be broken; while, on the other hand, if too little be added the gas will be developed in insufficient amount. From numerous examinations and tests, it has been found that the normal pressure of the best champagnes is about five atmospheres at a temperature of 10° C., and this is a maximum amount, which should not be exceeded. It has been found also by experiment that a gram of crystallized sugar, by the action of fermentation, will produce 0.247 liter of carbonic-acid gas and 0.643 cubic centimeter of alcohol. The amount of unconverted sugar in the wine can easily be determined by means of the apparatus called the gluco-enometer. Mr. Salleron has calculated the coefficient of the absorption of the gas at a temperature of 10° C., without pressure, to be 0.820 liter, and, therefore, to produce a pressure of five atmospheres, 5 times 0.820, or 4.1 liters, is the volume of gas which should be liberated by fermentation from the sugar. The amount of sugar necessary to produce this amount of gas is found by dividing 4.1 liters by 0.247, the amount stated above to be produced by one gram of crystallized sugar, the quotient of the operation being 16 grams; therefore an amount of free sugar should be added to the wine per liter to bring the content of unconverted sugar up to 16 grams. The crystallized sugar added to the wine is dissolved in a good white wine, usually of the same vintage as the wine to be bottled. The sirup thus produced, containing a known quantity of pure cane sugar, is added to the wine, in an immense cask, provided with a powerful agitator, which not only insures the thorough mixture of the sugar, but also results in the aëration of the wine, which is essential to the satisfactory development of the ferment.

First Bottling.—The wine is now ready to be bottled, and in the accomplishment of this there are two methods each having its own advocates and each possessing certain advantages. One consists in bottling the wine in a cellar at a temperature of 15° to 20° C. and the other in the cooler, deeper wine caves at a temperature of 8° to 9° C. The difference in the two methods is supposed to be the slight change which results in the foaming character, but in many of the larger wineries of Champagne both methods are combined as follows: The wine is bottled and the fermentation allowed to begin in a cellar at the higher temperature and when the pressure has

reached about four atmospheres the bottles are lowered into the inferior cellar or cave and maintained at a lower temperature until the maximum pressure of five atmospheres is reached. The work of bottling should be done with all possible expedition, since, after the addition of the sugar, the fermentation will begin at once and there will be a constant loss of the gas. The bottles are of a special quality and must be very strong to resist the pressure of the gas, and they are always cleaned and prepared with the utmost care. The transference of the wine to the bottles is made either with a small faucet or, in the larger establishments, by means of a siphon. The corks are of a special brand and exceptional quality and are inserted by means of machines which have already been described. The fastening of the cork is done either with a wire or with a special clasp which is forced over the cork and hooked to the neck of the bottle by a special machine, with which a skilled workman can fasten from two to three thousand bottles per day.

Measuring Pressure of Gas.—The sole object of the special treatment of these wines is the production of the carbonic-acid gas which causes their peculiar foaming characteristics, and it is of interest to be able to determine at any time after bottling the degree to which the carbonic-acid gas has been produced. For this purpose an instrument called the manometer has been devised, which may be introduced into a number of bottles in each lot and can be examined from time to time to record the pressure in atmospheres. This little glass instrument is represented at Fig. 188. It is introduced into the bottle with the wine after the short branch containing mercury has been broken at the tip. As the pressure of the gas in the bottle increases, the mercury is driven up in the longer graduated tube. One or two bottles containing these instruments in a rack holding one hundred or more are sufficient to determine the rate of development of the gas.



FIG. 188.—The Manometer. (Copied from *Partes and Ruyssen*).

In addition to the small manometer already described, a special apparatus has been devised by Salleron to determine more exactly the pressure of the gas in the bottles. This instrument is shown at Fig. 189. It consists of two distinct parts, one a steel tube or probe, S, surmounted by a stopcock and manometer, M. In place of the removable manometer a cap, P, may be screwed to the upper extremity. The probe is closed at the tip by a small steel tip. In using the instrument the cap, P, is screwed on in place of the manometer and the probe is thrust through the cork until the point projects into the liquid, when the steel point will fall of its own weight, leaving the tube in direct connection with the interior of the bottle. The manometer is then screwed on in place of the cap P, and on

turning the stop-cock the pressure is indicated on the dial. The amount indicated will always at first be considerably below the true pressure and the latter will not be shown until the bottle has been vigorously agitated. This test should be made with the liquid at a temperature of 10° C.

Trays for Storage of Bottles.—For the storage of the wine in bottles special racks or trays are made, which are so constructed that the bottles are sufficiently separated to prevent injury to the neighboring bottles in the event of the explosion of any of them. A single tray will frequently contain ten thousand bottles and the separation serves also to diminish the rise in temperature which the fermentation occasions. When, by inspecting the bottles containing the manometers, the pressure is found to have reached about four atmospheres, the trays containing the bottles are lowered bodily by means of derricks into the lower cellar or cave, there to remain until the transformation of the sugar into alcohol and carbonic-acid gas has been completed.

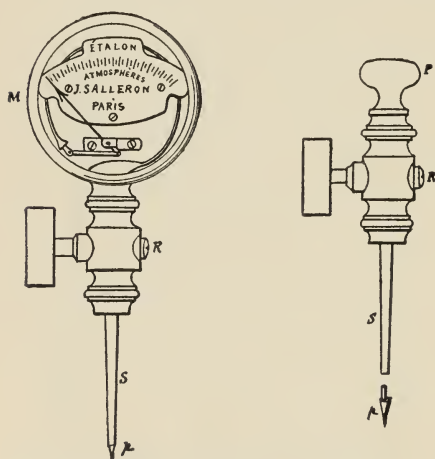


FIG. 189.—Salleron's instrument to measure the pressure in champagne bottles.

Subsequent Manipulation of Bottles.—The wine is left in this condition for a year or two to obtain the complete transformation of the sugar and to develop the special ethers or bouquets which give the wines of each famous vineyard their distinctive character. At the end of the first year, however, or about November or December, it is necessary to change the positions or rotate the bottles on the trays to prevent the adherence to the glass of a certain sediment or lees which will be precipitated by the fermentation. At the end of a

year or two this fermentation will have been completed and the wine will have become perfectly clear. It is now necessary to remove the sediment which has collected in the bottle. This is done by placing the bottles in trays in such a manner that the neck points downward at an angle of about 60 degrees, and each day for a period of six weeks or two months they are regularly gone over and each bottle turned half way about, which results in causing the lees or sediment to collect about the cork, leaving the sides of the bottle and the wine itself perfectly clear. If the wine has been properly treated and sufficient tannin has been left in it, the deposit will be more or less granular and pulverulent and will, by a slight agitation, easily be caused to pass through the liquid and collect on the cork. An

insufficient percentage of tannin will sometimes result in a deposit on the glass which adheres to it and can not easily be removed, or again sometimes results in a sediment which remains suspended in the liquid. In this case it is very difficult to improve the wine or remove the sediment, and the only means is to open the bottles and add a small amount of sizing and pure tannin, which will cause the formation of the granular sediment.

Removal of Lees and Rebottling.—The deposit which has accumulated on the cork is removed by taking the bottle carefully in hand without agitating or reversing it, and by a suitable machine removing the clasp which retains the cork, when the latter will be immediately forced out with an explosion by the pressure of the gas, and with it will be forced out the deposit which will have accumulated on the cork. At the moment this occurs, the workmen dexterously turns the bottle up, so that the liquid is not lost, and closes it with a temporary cork.

The wine in its present condition, however, is not by any means perfect. It is much too acid and is sometimes astringent, and to be rendered suitable for the consumer the addition is made at this point of a certain amount of sugar dissolved in an old and excellent wine which is free from germs of fermentation and carefully filtered. This serves to ameliorate the wine and also make up the loss occasioned in removing the deposit. The amount of sugar is not limited by the amount of loss following the removal of the cork, but is determined in advance for each brand of wine, and when necessary an additional amount of wine is removed to allow of the introduction of a larger amount of sugar. This is one of the steps in which no definite rule can be given and in which experience alone will teach the proper amount to use. Its importance, however, is very great, as on this addition will depend very largely the character of the finished product. The bottle is then carefully re-corked with a new cork, which usually bears the stamp of the château and is fixed in place as before. The bottle and cork, however, are now ornamented and labeled as seen in the market.

For the wines of the province of Champagne the bottles are of special quality and are made at a limited number of glass works in the departments of Marne and Aisne. The corks are obtained from Spain. The sugar used in the additions to the wine is obtained from cane grown in the neighborhood of Mantz, where the manufacture of the pure article has been followed from time immemorial. One of the chief exhibits at the Exposition was that by the Syndicat du Commerce des Vins de Champagne, which includes a large number of the more important vineyards of that ancient province.

Champagne wines may be preserved for a long time on the condition that as soon as the bottles are received they be stored in a cool, fresh cellar. Before being used they should be allowed to rest for fifteen days or three weeks.

RAISIN WINE.—Owing to the ravages of the *Phylloxera* and of various cryptogamic diseases which have greatly reduced the grape crop of France, the manufacture of wine from dried grapes—currants or raisins—has now assumed considerable proportions. It has caused France to become the chief consumer of the vine products of other countries, and to rely on foreign countries, particularly the fertile regions of the Levant, and also to some extent on the vineyards of California for the material for the manufacture of this kind of wine, the annual consumption of which has reached several million hectoliters. The production of this sort of wine is not, as commonly supposed, of French origin, but has been practiced from time to time in almost every vine-growing country. Hitherto, however, it has been produced only in small amounts and as a temporary expedient, and it has never attained the proportions it now exhibits in France.

The subject of making wine from dried grapes has given rise to lengthy discussions as to the merits of the product, but the conservative opinion seems to be that if the manufacturer is content merely to supply the amount of water lost by drying, so as to bring the grape back to its normal condition, a special alcoholic wine can be produced which is similar in composition with that made from the fresh grapes. The fermentation is, however, not perfect, and the wine produced is necessarily of inferior quality and is similar in composition to second wine. If, however, the addition of water is in excess of the natural amount found in the grapes (and the temptation to do this is frequently present, owing to the extreme richness in sugar of the currant or raisins) artificial wine is produced which is necessarily inferior to the wine produced by the addition of the normal quantity of water in all the elements except the percentage of alcohol.

The dried grapes for this purpose are very largely obtained from the Morea and the Ionian islands, and are chiefly the product of the famous black Corinthian grape, known in the markets of the world as currants (corruption of Corinth). The Corinthian grape is small and seedless, growing in small compact bunches, and has been introduced into California, but is not yet grown there in marketable quantities. The method of preparing these grapes for market is interesting. They ripen from the 20th of July to the 18th of August, but are not gathered from the vines until from the last of August to the middle of September. The gathering is done by women and children in large baskets and the grapes are carried to large rectangular earthen floors or elevated areas which are slightly inclined to allow the rain to run off freely. The surface of these tables or elevated sun-drying floors is plastered over with fresh cow dung or dung mixed with water, which hardens and furnishes a smooth surface almost free from odor. The grapes are spread

out on the surface of these platforms and allowed to remain there day and night, care being taken to turn them over every 24 hours. In a fair season they will dry in eight or ten days; but in a rainy season from twenty to thirty days will often be necessary, and, if the rains are very excessive, the crop is frequently lost. The dried raisins are carefully separated from the stems, cleaned, all foreign bodies removed, and then stored in buildings specially constructed. These are hermetically closed, except for an opening above, through which the currants are introduced, and one at the bottom from which they are extracted for shipping, and which is never opened except when they are to be removed for this purpose. The currants introduced through the upper opening of the structure are compressed by their own weight and also artificially, until eventually they form a solid mass which holds together very firmly by the escape of a viscous liquid. In removing them for transport to foreign markets it is necessary to use an iron prod to detach pieces from the mass, and these pieces are packed in small barrels and compressed into a solid mass by tramping with feet, which compression serves to protect them from the exterior air and allows of their being transported in excellent condition to all parts of the world. The production of currants from this grape in the regions named is in the neighborhood of twenty million pounds annually, of which less than one-fifth is used for home consumption, the balance being exported to England, France, the United States, etc.

Dried grapes or raisins are also obtained in large quantities from Asia Minor, where both the black and the white grapes are employed; Malaga on the south coast of Spain, and Valencia on the east coast; and in smaller quantities from Italy, California, and Chile.*

The Method of making Wine from dried Grapes.—In the manufacture of wine from dried grapes the same methods and processes are followed as in ordinary wine-making, except that owing to the different conditions some slight variations are made and greater precautions have to be taken. After being removed from the sacks or barrels in which they have been packed, the raisins are broken up into small lots and carefully examined, all moldy, fermented, or insect-injured grapes being removed. The water added to the raisins to make up for the amount lost by evaporation should be pure and not charged with foreign salts, particularly bicarbonate or sulphate of lime, which will retard the fermentation and give rise to very disagreeable odors.

**Raisin product for 1889.*

	Tons.		Tons.
Greece	125,000	California	10,000
Smvrna.....	120,000	Malaga	8,000
Valencia.....	28,000	Scattering (about)	10,000
Italy.....	15,000		

Rain or spring water, particularly water coming from gravelly or granitic soils, is preferable. The raisins are placed in a vat of water, in the proportions of 100 or 150 liters of water to 100 kilograms of raisins. In from thirty-six to seventy hours afterwards, according to the temperature, the raisins will have regained their natural form and size, and will have softened sufficiently to be easily crushed. This operation is of very considerable importance, as it is necessary to have each grape broken open in order to permit its contents to be easily and completely acted upon by fermentation. If this is not done, the action of fermentation will be slower, and there will be a loss, owing to the failure of all the contents of the berries to be transformed by fermentation. The amount of water to be added to the raisins has been determined by careful analysis and will vary with the percentage of alcohol which it is desired to have in the wine. After crushing, the grapes and liquor are introduced into large vats to undergo fermentation and constitute a must analogous to the true must of the fresh grape. It is sometimes necessary to heat the must to accelerate the fermentation, or it is advisable to introduce into the must some wine in an active state of fermentation, if any such be accessible, which will start the action of fermentation at once. The collection of the solid part of the must on the surface of the liquor, forming a cap or chapeau, should be prevented by some of the means described in the early part of this article, and the action of fermentation should be carefully measured from time to time by the aid of the thermometer and glucometer. After the action of the ferment has ceased, the wine is racked off very carefully, the marc is pressed, and the product added to the racked wine after having been clarified independently. The racking is repeated after a few days, and if, after standing for a long time, the liquid is not sufficiently clarified, it is treated with finings until perfect limpidity is secured. The wine thus produced, while a palatable and wholesome drink, can not be classed with the wine produced from the natural grape, and strict laws have been enacted in France to prevent its sale except under its true character. Unfortunately these laws do not protect other countries, and the raisin wines exported often do not bear any indication of their true character. A partial protection to the consumers from deceit in this matter comes from the activity of the producers of native grape wines in France, the reputation of whose products is necessarily injured by the placing on the market of these inferior wines as true products of French soil.

SECONDARY PRODUCTS OF THE GRAPE.

Uses of the Husks and Lees.—From the husks and lees a number of valuable products are obtained. These are the *piquettes*, sour wines, the second wines, or *vins de marcs*, and, by distillation, brandies

and tartar. They are also afterwards employed as fertilizers and as food for animals. These products will be very briefly referred to.

Second Wines, or Vins de Marcs.—The husks, after pressing, still contain a considerable quantity of liquid estimated at from one-fifth to one-fourth of the total product, and also tannin, sugar, and more or less coloring matter and other principles not completely removed by the first fermentation.

In the manufacture of second wines, water to the amount of half the wine already drawn off is added to the husks, which have been replaced in *cuves*, or fermentation vats, and sufficient sugar to give from 7 to 8 per cent of alcohol. It is advisable to first dissolve the sugar in the water, raising the latter to a temperature of from 33° to 35° C. to facilitate fermentation. The tartaric acid and tannin is sometimes in too small quantity in the second wines, and it is customary to add to the *cuve* from 25 to 30 grams of the first, and 5 to 8 grams of the second for each hectoliter of the second wine. The following treatment is as in the manufacture of the first wines.

With very highly-colored grapes third and even fourth wines are made, larger and larger quantities of tannin and tartaric acid, however, being required.

By mixing the second wines with coarse and highly-colored first wines, such as those produced from the American grapes, Jacquez and Cynthiana, a very fair cheap wine is obtained, which, if sold under its proper designation, may be recommended.

Piquettes.—These cheap but slightly alcoholic sour wines are obtained by adding pure water to the husks or marc, either before or after pressing. In the former case the product will contain the press wine, and be consequently of a higher grade. The manufacture of *piquettes* is very simple. A cask is filled and pressed tightly with the marc, the head is then replaced, and water is introduced at the bung until the cask is completely filled, when the bung is closed. In the course of time a light wine having 3 to 4 per cent of alcohol is produced, which does not keep long, but which furnishes a cheap and very healthful beverage. *Piquettes* are improved by mixing with other wines, or brandy is obtained from them by distillation.

Brandies.—Brandies are obtained either by distilling the marc direct or by the distillation of *piquettes*. The former method results in a brandy of rather disagreeable taste, the latter in a very palatable drink. The quantity of brandy is often increased by adding sugar to the marc in the *cuve*.

The marc from which white wine has been made is richer in the desirable elements, and is especially valuable for the manufacture of brandies or second wines. It enters rapidly into fermentation, and produces an excellent brandy.

The disagreeable taste attaching to brandies distilled directly from the marc limits somewhat this method of manufacture.

One of the latest improved stills or alembics and the process of distillation may be briefly described as follows :

The Deroy still (Fig. 190) comprises in the main ; a copper boiler in which the marc with a small quantity of water is placed ; a furnace, 14, a reservoir, 3, in which the alcoholic vapors are received and from which they pass into the worm 7, where they are condensed by means of cold water in the surrounding reservoir 8. The minute features of the apparatus need not be described in this place. The stills are either stationary or mounted on wheels to facilitate their transportation from place to place.

In the distillation of piquettes, the apparatus and methods are practically the same as in the case of the distillation of marc direct;

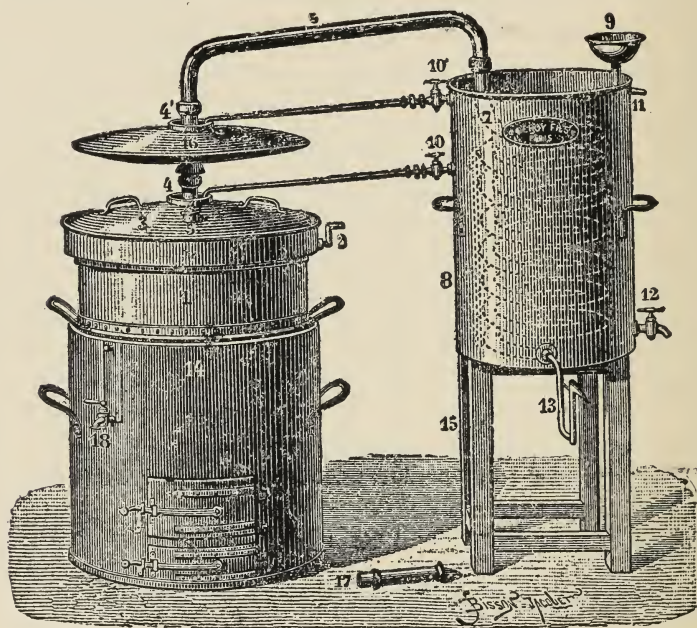


FIG. 190.—The Deroy still or alembic. (From Rougier.)

the operation, however, is continuous, it not being necessary to check it to empty and refill the boiler or vat.*

Tartar.—The tartar, a combination of potassium bitartrate and other matters, is obtained or dissolved from the marc, after the alcohol has all been drawn off, by filling the boiler 1 (Fig. 190) with water and causing the mixture to boil slowly for an hour or less. The boiling water is drawn off into vessels and on cooling the tartar crystallizes out. From 1 to 1½ kilos of crystallized tartar are obtained per hectoliter of marc. From the crude tartar thus obtained is

* Since this was in type the subject of brandy distillation has received very thorough treatment in Appendix A of the Biennial Report of the State Viticultural Commissioners of California for 1891-'92, which includes, also, a translation of Antonio Dal Piaz's work on cognac manufacture, which is one of the best of the foreign treatises on the subject.

manufactured potassium bitartrate or "cream tartar," and also tartaric acid.

The Husks or Marc as Fertilizers and Food.—As food the marc is mixed with oats or other grain and fed to cattle, horses, and particularly sheep. It is either fed out at once or preserved as ensilage.

As a fertilizer, the marc is mixed with other manure, to form composts, and is supposed to be especially valuable as an application to vine lands by returning to the soil the elements extracted by the grape.

THE WINE ESTATE OR CHÂTEAU.

One of the first subjects that will impress the student of French wine making are the almost innumerable houses or châteaux in celebrated wine districts, each bearing a distinctive name which brands its output of wine.

An idea of the character of these places will be obtained from the following brief reference to the region of the Gironde, including the districts about Bordeaux, which is beyond question the most famous wine region of France. Bordeaux is situated on the Garonne, and is a city of considerable manufacturing and commercial importance, but these interests are small compared with its trade in wines, and in the stores where wine is handled and in the cellars where it is placed centers the real business of the city. The department of the Gironde occupies an area of more than 2,500,000 acres, about one-fifth of which is planted to vines. The vineyards extend along the banks of the Gironde and Garonne rivers, and according to their situation or the nature of the soil the wines of the Bordelais are classed and generally known as the wines of the Cotes, Graves, Palus, Entre-deux-Mers, etc. In this territory the most famous is the Médoc district, which stretches from Bordeaux to the sea in one direction and lies between the rivers and the district known as the Landes. It comprises a small tongue of land, which is almost a peninsula and which is entirely planted to vines, and along the river for a distance of 40 miles and an average of 5 or 6 miles in width nothing is met with but vineyards. These are separated into small communes, each of which bears some ancient or celebrated name, as Margaux, St. Julien, etc., but in some cases these communes are of considerable extent and comprise distinct and well-known brands of wine, each the production of a distinct house. In this way the Margaux commune includes a large number of châteaux, and this condition of affairs results very frequently in erroneously ascribing all the wines from this commune to a particular château included in it bearing the same name, whereas there are half a dozen other equally important houses.*

* A point may be mentioned here which is not generally considered by foreign purchasers, namely, the taking the brand of a wine as an index of its quality. For instance, the clarets produced by a particular house in different years will vary in price from \$30 to \$300 per hogshead, the difference depending on the success or nonsuccess of the vintage of the different years.

The great majority of the châteaux in Médoc are simple country seats, often of no very great importance, in which the proprietor resides from time to time, and generally only during the vintage. The wines as they are quoted in the market usually bear the name of some château or other, and the fame of some of these places has become world-wide. Formerly the term château was applied to one of the old manorial residences and a resemblance to the old condition of affairs is still maintained in many cases by the antiquity of the buildings and the baronial style of architecture. Others are constructed in more modern style. The cultivation of the vineyards which cover the hillside surrounding the house or castle is accomplished chiefly by means of oxen, horses, however, being also employed; and the more delicate work of the vineyards, such as the pruning and care of the vines during fruitage, and the destruction of the various insect pests, is done by women, who, in their neat dresses, present a very picturesque appearance in the vineyards. All the laborers, cattle, horses, etc., employed in the vineyards are accommodated in small outbuildings adjoining the château, about which also are ranged the press houses and cellars in which the wines, after being drawn from the hogsheads, are placed for permanent keeping. Some of these cellars are of immense size and the long rows of hogsheads in them present an imposing spectacle. In them the wine is bottled and stoppered with a special cork bearing the name of the château. In these cellars the best wines are kept for long periods to develop the special qualities coming only from age, which give them their reputation.

To develop similar distinctive qualities should be the ambition of our American wine-makers, and this will not be attained until our best types are properly stored as they are in France, long enough to become thoroughly ripened and developed.